Aug. 9, 1966 G. P. KOCH 3,265,229

AUTOMATIC BUCKET POSITIONING MECHANISM

Filed Dec. 2, 1963 2 Sheets-Sheet 1

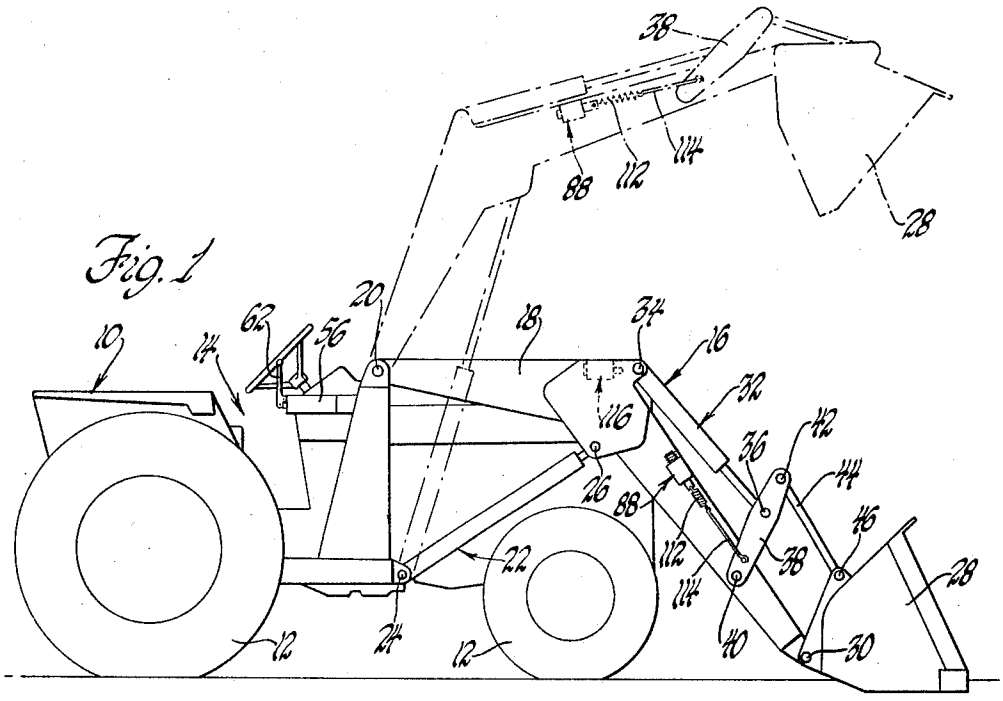


Fig. 1

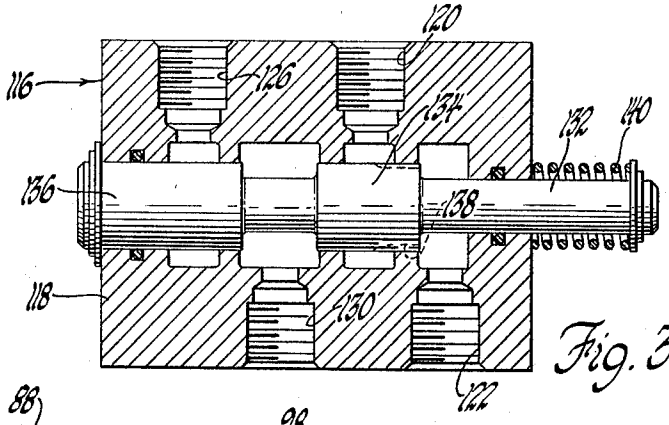


Fig. 3

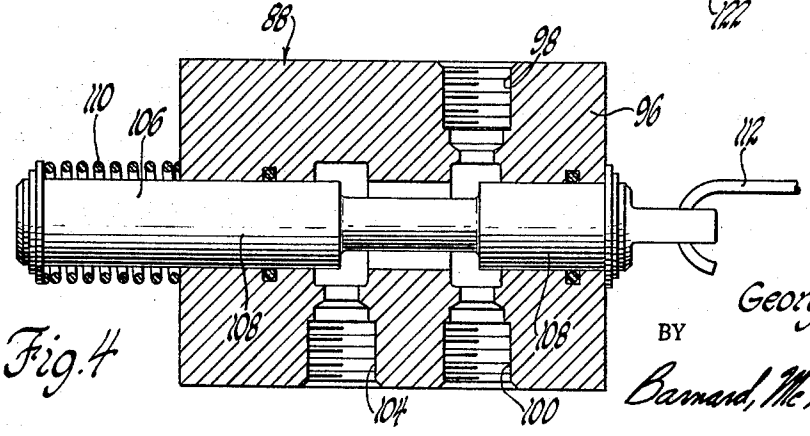


Fig. 4

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AUTOMATIC BUCKET POSITIONING MECHANISM

Filed Dec. 2, 1963 2 Sheets-Sheet 2

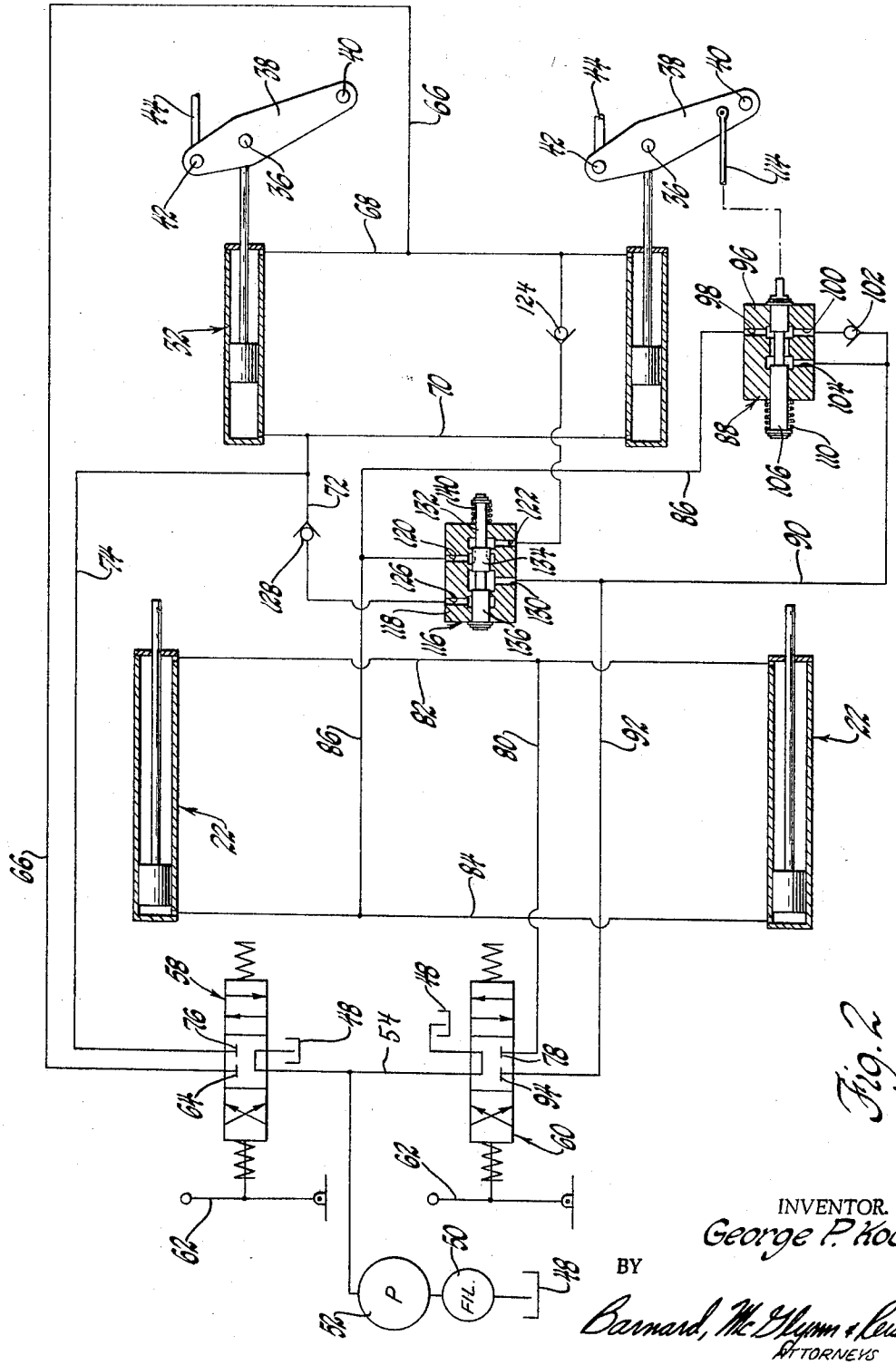


Fig. 2

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AUTOMATIC BUCKET POSITIONING MECHANISM

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11 Claims. (Cl. 214—140)

This invention relates to a material handling apparatus such as loaders and the like and, in particular, to a front end loader characterized by means for automatically disposing the material handling bucket thereof in a low level digging position in response to lowering of the bucket-supporting boom from a high lift dump position or the like.

Referring to front end loader vehicles as an example of one type of material handling apparatus with which the present invention may be used to advantage, such loader vehicles typically comprise a boom pivotally mounted on a mobile vehicle for raising and lowering movement relative thereto, a bucket pivotally mounted on an extreme end of the boom for movement between digging and dumping positions relative thereto, hydraulically operable boom and bucket jacks respectively suitably carried by the vehicle and connected to the boom and bucket to control movement thereof, and a suitable fluid pressure circuit means including manually operable boom and bucket selector valves to selectively control independent operation of the boom and bucket jacks and, hence, vertical movement of the boom and pivotal movement of the bucket thereon.

One typical cycle of operation of such a loader vehicle comprises approaching a load of material to be dug or otherwise picked up with the boom disposed in a lowered position and the bucket disposed relative thereto in a digging position; that is, with the floor of the bucket disposed in a generally horizontal material-receiving position although, of course, the digging position may be varied from the aforementioned position in accordance with other operating conditions such as, for example, the desire of the vehicle operator to dig down from ground level. In any event, after a load is dug, the vehicle operator will often operate the bucket selector valve to roll or curl the bucket rearwardly about its mounting on the boom to dispose the bucket in a low level load retaining position. Thereafter, the boom jacks will be energized by shiftinfi the boom selector valve to raise the boom to a desired position for subsequent dumping. When the desired boom elevation is reached, as with respect to a truck into which the contents of the bucket are to be dumped, the bucket selector valve in again shifted to this time roll or curl the bucket forwardly about its mounting on the boom to dispose the bucket in a dumping position; that is, a position in which the aforementioned floor of the bucket extends at an angle below a horizontal plane through the pivot axis of the bucket on the boom. As a result, the contents of the bucket are discharged. Thereafter, the vehicle operator will begin to manipulate both the boom and bucket selector valves in an effort to once again dispose the boom and bucket in their low level digging positions. In other words, either jointly or independently, the boom and bucket selector valves must be manipulated to again lower the boom while at the same time rolling the bucket rearwardly about its mounting on the boom to again assume the desired digging position.

As will be readily appreciately by those acquainted with this art, considerable skill, often lacking, is required of the operator of such a loader vehicle in efficiently and expeditiously returning the loader apparatus to the low level digging position while manipulating the selector valves aforementioned. However, even apart from

dexterity, coordination and timing required of the vehicle operator in this regard, a further problem is presented due to difficulty of observing the position of the bucket once it approaches ground level; that is, in the typical installation, the bucket is disposed in front of the vehicle relatively remote from the vehicle operator's position and below his line of sight so that, even if he does efficiently return the boom and bucket to an approximate low level digging position, it is extremely difficult for him to make any final adjustment required to provide the actual bucket digging position desired.

In view of the foregoing considerations, the present invention is directed to a loader vehicle of the general type aforementioned comprising a boom pivotally mounted on a vehicle for movement between raised and lowered positions relative thereto, fluid pressure operated boom jacks operatively connected between the vehicle and boom to move the latter between its positions, a material handling implement, such as a bucket, pivotally mounted on the boom for movement between predetermined positions, such as digging and dumping positions, relative thereto, and fluid pressure operated bucket jacks operable on the bucket to move the latter between its positions aforementioned, and is particularly characterized by control means for automatically moving the bucket or other implement to its digging position or the like in response to movement of the boom toward its lowered position, thereby completely eliminating the requirement of any operator-attendance whatsoever to the bucket selector valve in finally disposing the bucket in the desired digging position.

More specifically in this regard, the present invention is particularly characterized by the fact that the fluid circuit means provided for supplying fluid under pressure to the boom and bucket jacks to accomplish their normal functions at all times communicates exhaust fluid from the boom jack as the boom is lowered to the bucket jack to tend to operate the latter to move the bucket from a dumping position to the digging position thereof, and control valve means are provided in such circuit means for controlling the flow of such exhaust fluid and to permit such flow so long as the bucket has not reached the desired digging position but, once such digging position is reached, such flow is interrupted while operating fluid may still be supplied to and exhausted from the boom jack in the event that it still requires further lowering.

More specifically, the present invention is further particularly characterized by the fact that the aforementioned control valve means comprises a first control valve having a first position preventing exhaust of fluid from and operation of the bucket jack independently of the bucket selector valve, and a second position permitting such exhaust and operation, the first control valve being movable automatically from its first to its second position in respone to the pressure of fluid being exhausted from the boom jack as the boom is lowered while the bucket is displaced from its final desired digging position, a second control valve having a first position preventing fluid exhausted from the boom jack from being returned to the source or low pressure side of the circuit means, and a second position permitting such return, and means operatively connecting the bucket to the second control valve to automatically dispose the latter in the first and second positions thereof, respectively, with the bucket in said dumping and digging positions thereof.

As a result, at any time that the bucket is displaced from the digging position toward the dumping position thereof, the aforementioned second control valve will occupy its first position aforementioned to prevent exhaust from the boom jack from being returned to source, and necessitating it to flow to and operate the bucket jack to move the bucket toward the digging position, ex-

haust from the bucket jack being supplied through the first control valve aforementioned which has been shifted to its second position as a result of the second control valve being disposed in the first position thereof. As soon as the bucket reaches its digging position, however, the second control valve is automatically disposed in its second position permitting exhaust fluid from the boom jack, as the boom may be further lowered, to be returned through the second control valve to the source to interrupt any further operation of the bucket jack.

The present invention is further characterized by the fact that, notwithstanding the fluid intercommunication between the bucket and boom jacks during automatic positioning of the bucket in a digging position as the boom is lowered, the bucket and boom jacks are otherwise completely independently operable in the manner of conventional loader vehicles.

In order to facilitate an understanding of the invention, a preferred embodiment thereof will now be described with reference to the enclosed drawings in which:

FIGURE 1 is a side elevational view of a loader vehicle illustrating a preferred embodiment of the invention, the loader linkage being shown in solid line in a low level digging position and in phantom line in a high lift dumping position;

FIGURE 2 is a schematic illustration of the hydraulic circuitry and components of the fluid power system of the vehicle of FIGURE 1;

FIGURE 3 is a sectional view of a control valve included in the system of FIGURE 2; and

FIGURE 4 is a sectional view of another control valve included in the system of FIGURE 2.

Referring now to the drawings, and particularly FIGURE 1 thereof, the numeral **10** generally indicates an agricultural tractor or other mobile vehicle having the usual ground-engaging wheels **12** and operator's station **14**. A front end loader linkage is indicated generally at **16** as being mounted on vehicle **10**, such linkage preferably comprising paired booms or lift beams and associated bucket tilt linkages which are identical in construction. Thus, only one side of such linkage is shown in FIGURE 1.

Thus, each boom or lift beam **18** has one end thereof suitably pivotally mounted on a horizontal transverse axis **20** to the frame of the vehicle **10** and is adapted to be adjusted vertically relative to the vehicle between the positions illustrated in FIGURE 1 by a boom jack **22** having its cylinder element pivotally connected at **24** to the main frame of the vehicle and the piston element reciprocably disposed therein pivotally connected at **26** to the boom intermediate the ends of the latter.

A conventional loader bucket **28** is pivotally mounted on the horizontal transverse axis **30** on and between the forward ends of the booms **18**. Rolling movement of the bucket **28** between the low level digging position and high lift dumping position illustrated tn FIGURE 1 is controlled by a bucket tilt linkage of which there is usually a pair as aforementioned, one for each lift beam or boom **18**. Each such tilt linkage is illustrated as comprising a bucket tilt jack **32** having the cylinder element thereof pivotally connected at **34** to the boom **18** intermediate the ends of the latter and the relatively reciprocable piston member pivotally connected at **36** intermediate the ends of a tilt lever **38** pivotally connected at **40** to the boom **18** and at **42** to one end of a tilt link **44** having its other end pivotally connected at **46** to the bucket on an axis spaced from the axis of the pivotal connection **30** of the latter on the booms. As will be appreciated, extension and retraction of the boom jacks **22** under fluid pressure and in a manner to be described more fully hereinafter will result, respectively, in raising and lowering of the booms **18** between the positions illustrated in FIGURE 1. In similar fashion, extension and retraction of the bucket tilt jacks **32** will result, respectively, in rolling the bucket clockwise and counterclockwise in FIGURE 1 between dumping and digging positions relative to the booms and the ground.

The fluid system for controlling operation of the aforedescribed construction comprises a reservoir **48** for a suitable operating fluid, such as oil, for delivery through the filter **50** to the inlet of a suitable pump **52** which discharges such fluid under a suitable and desired pressure to the inlet gallery **54** of a valve manifold illustrated at **56** in FIGURE 1 as mounted at operator's station **14**, and housing the bucket and boom selector valves indicated generally and respectively at **58** and **60** in FIGURE 2. As is indicated in FIGURES 1 and 2, both the bucket and boom selector valves are the type including a manually shiftable valve spool operatively connected to the pivotal operating levers **62**. Furthermore, and as further illustrated, the selector valves are of the self-centering type; that is, of the type in which spring means are utilized to normally dispose the shiftable valve spools in a neutral or centered position preventing any flow whatsoever from the gallery **54** through the respective valves to the various instrumentalities controlled thereby and, to further prevent any such reverse flow of fluid from such instrumentalities through such valves to the reservoir.

It will be seen that one port **64** of the bucket selector valve **58** communicates through the conduit **66** and branch conduit **68** with the piston rod sides of the respective bucket tilt jacks **32**, while the piston head sides thereof are connected through the branch conduit **70**, conduit **72** and conduit **74** to the other port **76** of the bucket selector valve **58**.

In somewhat similar fashion, one port **78** of the boom selector valve **60** is connected through the conduit **80** and the branch conduit **82** to the piston rod sides of the respective boom jacks **22**, while the piston head sides thereof are communicated through the branch conduit **84**, conduit **86**, control valve **88** suitably mounted on one of the booms **18**, and conduits **90** and **92** to the other port **94** of the boom selector valve.

More specifically in this regard, and referring particularly to FIGURES 2 and 4, the control valve **88** comprises the valve body **96** including the port **98** communicating with conduit **86**, opposed port **100** communicating through the one-way check valve **102** with the conduit **90**, and the port **104** communicating freely with the conduit **90**. A conventional valve spool **106** having the axially spaced valve lands **108** is reciprocably disposed within the valve body **96** to control flow of fluid therethrough in a manner to be described hereinafter, the spring element **110** at one end of the spool continuously biasing the latter to the left in FIGURES 2 and 4 toward and to the position therein illustrated. The other end of the valve spool is connected through the spring element **112** illustrated particularly in FIGURE 1 and cable or similar motion-transmitting mechanism **114** to one of the tilt levers **38** so as to position the spool in accordance with the position of the bucket relative to the booms.

In FIGURES 1, 2 and 4, the control valve spool **106** is shown in its extreme leftward position which is the position it assumes immediately upon the bucket **28** reaching the digging position illustrated in full line in FIGURE 1. In such position, it will be manifest that fluid in the conduit **86** may flow from port **98** to port **104** and through the conduits **90** and **92** to the boom selector valve **60**. However, with the bucket rolled to the dumping position illustrated in phantom line in FIGURE 1, the spool **106** will be shifted to an extreme position to the right in FIGURES 2 and 4 wherein the lift valve land **108** prevents communication between the ports **98** and **104** of the control valve and, due to the presence of the one-way check valve **102**, fluid may not flow from the conduit **86** through control valve **88** to the conduit **90** and back to the boom selector valve. On the other hand, whether the spool of the control valve **88** is in the posi-

tion shown in FIGURES 2 and 4 or shifted to the extreme right as aforedescribed, it will be immediately clear that fluid may at all times flow from the conduit 92 through either the port 104 or past the check valve 102 and through the port 100 to the port 98, depending upon the particular position of the valve spool.

Another control valve 116 is suitably fixedly mounted on one boom 18, and is associated with the hydraulic circuitry aforedescribed and, referring particularly to FIGURES 2 and 3, comprises a valve body 118 having the port 120 communicating with conduit 86, port 122 communicating through the one-way check valve 124 with the branch conduit 68, the port 126 communicating through the one-way check valve 128 with the conduit 72 and branch conduit 70, and the port 130 communicating with the conduits 90 and 92. A conventional valve spool 132 is axially shiftably mounted within the valve body 118 and includes the valve lands 134 and 136 respectively controlling communication between the respective pairs of ports 120 and 122, and 126 and 130. The land 134 includes axially undercut portions 138 serving to insure communication between the ports 120 and 122 in the position thereof illustrated in FIGURES 2 and 3, as well as all other positions thereof as will become apparent hereinafter. The spring construction 140 at one end of the spool continuously biases the latter to the right and to the position illustrated in FIGURES 2 and 3, while permitting shifting movement of the spool to the left to respectively communicate ports 120 and 122 and ports 126 and 130 for free unrestricted communication therebetween. With the spool disposed in the position of FIGURES 2 and 3, the port 120 will communicate with the port 122 as aforementioned, but no flow is possible between the ports 126 and 130.

Referring now to the operation of the aforedescribed loader vehicle, it may be assumed that the loader linkage 16 and the components of the hydraulic circuitry associated therewith are all in the positions illustrated in the drawings; that is, that the booms 18 are lowered and the bucket 28 is disposed in its low level digging position as illustrated in full line in FIGURE 1, with the bucket and boom selector valves 58 and 60 in their neutral positions and the control valves 88 and 116 in the positions illustrated. It may now be further assumed that a load of material has been received in the bucket in the full line position of FIGURE 1, and that the vehicle operator now wishes to transfer the load for dumping into a truck or the like. At this time, he may shift the bucket selector valve 58 to the left in FIGURE 2 to communicate fluid under pressure from the manifold gallery 54 through the port 64 to the conduit 66. Fluid under pressure is thus supplied through the branch conduit 68 to the piston rod sides of the bucket tilt jacks 32 to cause them to retract to roll the bucket counterclockwise in FIGURE 1 about the pivot axis 30 to a low level load-retaining position in which the mouth of the bucket is disposed substantially horizontal to cradle the load in a non-spilling attitude relative to the ground. Check valve 124 prevents fluid so supplied from being communicated to control valve 116. As the bucket tilt jacks are retracted in this manner, fluid is exhausted from the piston head sides thereof through the branch conduit 70, conduit 72 and conduit 74 to and through the port 76 of the bucket selector valve to reservoir. Although fluid being exhausted from the bucket jacks may open the check valve 128 in conduit 72, it will be clear that fluid may not flow from the conduit 72 between the ports 126 and 130 of control valves 116 since the valve land 136 of the spool valve 132 prevents such flow, thereby insuring that all exhaust fluid from the bucket tilt jacks is returned to reservoir. The operator then releases lever 62 associated with the bucket selector valve to allow the latter to return to its neutral or centered position.

With the load so cradled, the vehicle operator may now shift the boom selector valve 60 to the left in FIGURE 2 to supply fluid under pressure from the manifold gallery 54 through the valve port 94 to the conduit 92, conduit 90, port 104 and past spool 106 of control valve 88 to port 98 thereof and conduit 86 to the branch conduit 84 and the piston head sides of the boom jacks 22. Thus, the boom jacks will be extended to raise the boom toward and to the phantom line position of FIGURE 1. As the boom is so raised, fluid is exhausted from the piston rod sides of the boom jacks into the branch conduit 82 and conduit 80 through the port 78 of the boom selector valve to reservoir. The boom selector valve is allowed to return to its neutral position after the booms have reached the desired elevation.

At this juncture, it should be noted that pressurization of the piston head sides of the boom jacks 22 for the purpose and in the manner aforedescribed results in delivery of fluid under pressure from the conduit 92 through the port 130 to the interior of the valve body 118 of control valve 116 between the valve lands 134 and 136. Due to the equal opposed areas of such lands, however, no shifting movement of the valve spool 132 occurs solely by reason of such pressure. However, such fluid under pressure is also delivered through the control valve 88 to the conduit 86 in the manner aforedescribed, and such conduit 86 communicates with the port 120 and through the undercut portions 138 in the valve spool land 134 to the port 122. Fluid so flowing from the port 120 to the port 122 will act upon the right-hand end of the valve spool land 134 to overcome the balanced pressure condition between the valve lands 134 and 136 and cause the valve spool to shift to the left in FIGURES 2 and 3 against the influence of spring 140. Pressure in the conduit 92 is then available to flow from the port 130 to the port 126 and into the conduit 72, but cannot flow any further due to the presence of the check valve 128. Thus, pressurization of the boom jacks in this manner does not extend the bucket jacks 32. Furthermore, operating fluid is prevented from flowing past check valve 124 to the rod sides of bucket jacks 32 to retract the latter, since fluid is trapped in the piston head sides thereof with the bucket selector valve 58 in its neutral position.

When the booms are elevated to the desired height as indicated by the phantom line position of FIGURE 1, the vehicle operator will then shift the bucket selector valve 58 to the right. As a result, pressure from the manifold gallery 54 will be communicated through port 76 to the conduit 74, conduit 72 and, hence to the branch conduit 70 and the piston head sides of the bucket tilt jacks 32. Fluid in conduit 72 is prevented from flowing past check valve 128 and control valve 116 since the latter is in the position illustrated. As a result, the jacks are extended to pivot the tilt levers 38 clockwise in FIGURES 1 and 2 to dump the bucket as illustrated in phantom line in FIGURE 1. In so dumping the bucket, exhaust fluid from the piston rod sides of the bucket tilt jacks is returned through branch conduit 68, conduit 66 and port 64 of the bucket selector valve to reservoir. Such exhaust of the bucket tilt jacks is prevented from communicating with the control valve 116 by means of the one-way check valve 124. The operator allows the bucket selector valve 58 to return to its neutral position after the bucket is dumped.

As soon as the bucket 28 is rolled clockwise from the position it occupies on and relative to the booms which provide a digging position when the booms are lowered as aforementioned, the valve spool 106 of the control valve 88 is shifted to the right in FIGURES 2 and 3 to prevent communication between the ports 98 and 104. Furthermore, to the extent that clockwise roll of the bucket to a dumping position exceeds the extent of travel permissible of the spool 106 relative to the valve body 96, the spring 112 forming a part of the connection between the valve spool 106 and the rod or cable mechanism 114 accomodates such additional bucket motion in the manner of a lost motion connection. It will also be apparent at this point that the relative positions of the booms and bucket at which the latter will shift spool 106, thereby determin-

ing the digging position desired, may be adjusted by adjusting the length of the cable or rod **114**.

After dumping the bucket in this manner, the vehicle operator may shift the boom selector valve **60** to the right in FIGURE 2 to communicate fluid pressure from the inlet gallery **54** through the port **78** to the conduit **80**, and through the branch conduit **82** to the rod sides of the boom jacks **22**. As a result, the boom jacks are retracted and lower the booms from the phantom line to the full line position of FIGURE 1. As these jacks are so retracted, fluid exhausted from the piston head sides thereof is communicated through the branch conduit **84** and conduit **86** to the port **98** of control valve **88**. However, with the bucket still displaced from its desired digging position, the valve spool **106** remains in its shifted position to the extreme right in FIGURES 2 and 4 thereby preventing any communication from port **98** to port **104**. Consequently, since flow from the control valve **88** from port **100** is prevented by the one-way check valve **102**, exhaust fluid from the boom jacks is trapped in the conduit **86**. As a consequence, the pressure of such exhausted fluid enters the port **120** of control valve **116** and passes through the undercut portions **138** of valve spool land **134** to act upon the right end of the latter and shift the valve spool to the left in FIGURES 2 and 3. As a result of such movement, the port **120** communicates with the port **122** to supply exhaust fluid from the boom jacks past the one-way check valve **124** to branch conduit **68** and the rod sides of the bucket tilt jacks **32**. As a result, the bucket tilt jacks begin to retract while exhaust fluid therefrom flows through the branch conduit **70**, and is prevented from flowing through the conduit **74** and bucket selector valve **58** since the latter is in its neutral position. However, such exhaust fluid flows through the conduit **72** and past one-way check valve **128** to the port **126** of control valve **116**. Since the valve spool of the latter valve is shifted to the left, the exhaust fluid from the tilt jacks is further communicated from the port **126** to the port **130** and conduit **92**, and through the port **94** of the boom selector valve to reservoir.

Either at the time that the booms **18** reach their extreme lowered position or some time prior thereto, usually the latter, the fluid interchange between the boom jacks and bucket tilt jacks as aforedescribed will have sufficiently retracted the bucket tilt jacks so as to automatically result in disposition of the bucket **28** in the desired low level digging position once the booms reach their lowered position. When such digging position is reached, and as sensed by pivotal movement of the tilt lever **38** and the connection of the latter to the valve spool **106**, the control valve **88** is returned to the position illustrated in FIGURES 2 and 4. At this time, the port **98** of the control valve is immediately communicated with the port **104** thereof for flow of boom jack exhaust fluid from the conduit **86** through the ports **98** and **104** to the conduits **90** and **92** and through the port **94** of the boom selector valve to reservoir. Since exhaust fluid from boom jacks is now free to return through the conduit **86** to reservoir in this manner, pressure is relieved from the right-hand end of the valve spool land **134** of control valve **116** resulting in the spring **140** shifting the latter to the right in FIGURES 2 and 3. As a result, valve land **136** prevents any further flow of exhaust fluid from the bucket tilt jacks through the conduit **72** to ports **126** and **130**. Hence, the bucket is automatically disposed in its digging position relative to the booms. When the booms reach the desired lowered position, the boom selector valve **60** is released and thereby automatically returns to its neutral position.

From the foregoing description, it will now be apparent that the present invention functions to automatically roll a loader bucket from a high lift dumping position to a low level digging position relative to a vertically adjustable boom in response to lowering of the latter. By the same token, raising of the boom or pivotal movement of the bucket on the boom in either of two directions may be accomplished totally independently from lowering movement of the boom. Furthermore, the bucket may be pivoted in either direction on the boom irrespective of the elevation of the boom at any given time. In other words, although lowering of the boom will automatically result in moving the bucket from the phantom line dumping position toward the full line digging position, it may for one reason or another be desired to stop the boom at an elevation intermediate those illustrated in FIGURE 1. At any such intermediate elevation, it will be readily apparent that actuation of the bucket selector valve **58** will result in pivotal movement of the bucket on the boom independently of operation of the boom jacks **22**. In short, the loader linkage **16** of the present invention provides all of the advantages of independent actuation of the boom and bucket of a conventional loader, while additionally providing for concert movement of the bucket and boom when lowering the latter from a high lift dumping position to automatically dispose the bucket in a low level digging position without any attention whatsoever of the vehicle operator.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In the combination comprising a material handling implement pivotally mounted on boom means for movement toward and from a predetermined position relative thereto, said boom means being pivotally mounted for raising and lowering movement thereof, and fluid pressure operated implement and boom means jacks respectively operable to move said implement and boom means; the improvement comprising fluid circuit means interconnecting said implement and boom means jacks, and control valve means in said circuit means operably connected to said implement to sense a position of the latter displaced from said predetermined position thereof, said control valve means being operable automatically in response to displacement of said implement from said predetermined position thereof and actuation of said boom means to lower the latter to move said implement toward said predetermined position thereof.

2. In the combination comprising a material handling implement pivotally mounted on boom means for movement toward and from a predetermined position relative thereto, said boom means being pivotally mounted for raising and lowering movement thereof, and fluid pressure operated implement and boom means jacks respectively operable to move said implement and boom means; the improvement comprising fluid circuit means interconnecting said implement and boom means jacks, and control valve means in said circuit means operably connected to said implement to sense a position of the latter displaced from said predetermined position thereof, said control valve means being operable automatically in response to displacement of said implement from said predetermined position thereof and actuation of said boom means to lower the latter to supply fluid from said boom means jack to said implement jack and automatically move said implement toward said predetermined position thereof.

3. The combination according to claim **2** wherein said control valve means is operable automatically to discontinue supply of fluid from said boom means jack to said implement jack upon said implement reaching said predetermined position thereof.

4. In the combination comprising a vehicle, boom means pivotally mounted on said vehicle for movement between raised and lowered positions relative thereto, fluid pressure operated boom jack means operatively interconnecting said vehicle and boom means and operable to move the latter between said positions thereof, a material handling bucket pivotally mounted on said boom means for movement between digging and dumping positions relative thereto, and fluid pressure operated jack means operable to move said bucket between said positions thereof; the improvement comprising fluid circuit means interconnecting said boom and bucket jacks, and

control valve means in said circuit means operably connected to said bucket to sense said dumping position thereof, said control valve means being operable automatically in response to said bucket being in said dumping position thereof and actuation of said boom means to lower the latter to supply fluid from said boom jack means to said bucket jack to automatically operate the latter and move said bucket toward said digging position thereof.

5. The combination according to claim 4 wherein said control valve means is operable automatically to discontinue supply of fluid from said boom jack means to said bucket jack upon said bucket reaching said digging position thereof.

6. In the combination comprising a vehicle, boom means pivotally mounted on said vehicle for movement between raised and lowered positions relative thereto, fluid pressure operated boom jack means operatively interconnecting said vehicle and boom means and operable to move the latter between said positions thereof, a material handling bucket pivotally mounted on said boom means for movement between digging and dumping positions relative thereto, and fluid pressure operated bucket jack means operable to move said bucket between said positions thereof; the improvement comprising fluid circuit means interconnecting said boom and bucket jack means, the improvement comprising first control valve means having a first position preventing flow of operating fluid from said boom jack means to said bucket jack means to operate the latter and a second position to permit such flow to supply fluid being exhausted from said boom jack means as said boom is lowered to said bucket jack means to operate the latter and move said bucket toward said digging position thereof, said first control valve means being movable automatically from said first to said second position thereof in response to the pressure of fluid being exhausted from said boom jack means as said boom is lowered with said bucket in said dumping position thereof, second control valve means having a first position preventing flow of fluid being exhausted from said boom jack means to a low pressure side of said circuit means and a second position permitting such flow, and means operatively connecting said bucket to said second control valve means to automatically dispose the latter in said first and second positions thereof, respectively, with said bucket in said dumping and digging positions thereof.

7. In the combination comprising a vehicle, boom means pivotally mounted on said vehicle for movement between raised and lowered positions relative thereto, fluid pressure operated boom jack means operatively interconnecting said vehicle and boom means and operable to move the latter between said positions thereof, a material handling bucket pivotally mounted on said boom means for movement between digging and dumping positions relative thereto, and fluid pressure operated bucket jack means operable to move said bucket between said positions thereof; the improvement comprising fluid circuit means interconnecting said boom and bucket jack means, said fluid circuit means at all times communicating exhaust fluid from said boom jack means as said boom is lowered to said bucket jack means to tend to operate the latter to move said bucket from said dumping to said digging position thereof, first control valve means having a first position preventing exhaust of fluid from and operation of said bucket jack means and a second position permitting such exhaust and operation, said first control valve means being movable automatically from said first to said second position thereof in response to the pressure of fluid being exhausted from said boom jack means as said boom is lowered with said bucket moved from said digging position thereof, second control valve means having a first position preventing flow of fluid being exhausted from said boom jack means as said boom means is lowered to a low pressure side of said circuit means and a second position permitting said flow, and means operatively connecting said bucket to said second control valve means to automatically dispose the latter in said first and second positions thereof, respectively, with said bucket in said dumping and digging positions thereof.

8. The combination according to claim 7 wherein said circuit means further comprises a boom selector valve for selectively supplying operating fluid to said boom jack means, and wherein operating fluid may be supplied from said boom selector valve through said second control valve means to said boom jack means in either of said positions of said second control valve means.

9. The combination according to claim 7 further comprising check valve means permitting one-way flow of fluid from said boom jack means through said first control valve means to said bucket jack means while preventing reverse flow therebetween during movement of said bucket jack means and said bucket from said digging to said dumping position of the latter.

10. In the combination comprising a vehicle, boom means pivotally mounted on said vehicle for movement between raised and lowered positions relative thereto, fluid pressure operated boom jack means operatively interconnecting said vehicle and boom means and operable to move the latter between said positions thereof, a material handling bucket pivotally mounted on said boom means for movement between digging and dumping positions relative thereto, and fluid pressure operated bucket jack means operable to move said bucket between said positions thereof; the improvement comprising fluid circuit means interconnecting said boom and bucket jack means, control valve means in said circuit means for automatically moving said bucket from said dumping to said digging position thereof in response to lowering said boom means, said control valve means comprising first control valve means having a first position preventing flow of operating fluid from said boom jack means to said bucket jack means to operate the latter and a second position to permit such flow to supply fluid being exhausted from said boom jack means as said boom is lowered to said bucket jack means to operate the latter and move said bucket toward said digging position thereof, said first control valve means being movable automatically from said first to said second position thereof in response to the pressure of the fluid being exhausted from said boom jack means as said boom means is lowered with said bucket in said dumping position thereof, second control valve means having a first position preventing flow of fluid being exhausted from said boom jack means to a low pressure side of said circuit means and a second position permitting such flow, and means operatively connecting said bucket to said second control valve means to automatically dispose the latter in said first and second positions thereof, respectively, with said bucket in said dumping and digging positions thereof, said last-named means comprising extensible spring means to accommodate further movement of said bucket from said digging toward said dumping positions thereof after said second control valve means has been moved to said first position thereof.

11. In the combination comprising a vehicle, boom means pivotally mounted on said vehicle for movement between raised and lowered positions relative thereto, fluid pressure operated boom jack means operatively interconnecting said vehicle and boom means and operable to move the latter between said positions thereof, a material handling implement pivotally mounted on said boom means for movement toward and away from a predetermined position relative thereto, and fluid pressure operated implement jack means operable to move said implement between said positions thereof; the improvement comprising fluid circuit means interconnecting said boom and implement jack means, control valve means in said circuit means for automatically moving said implement between said positions thereof in response to lowering said boom means, said control valve means comprising first control valve means having a first position

preventing flow of operating fluid from said boom jack means to said implement jack means to operate the latter and a second position to permit such flow to supply fluid being exhausted from said boom jack means as said boom is lowered to said implement jack means to operate the latter and move said implement toward said predetermined position thereof, said first control valve means being movable automatically from said first to said second position thereof in response to the pressure of the fluid being exhausted from said boom jack means as said boom means is lowered with said implement in said dumping position thereof, second control valve means having a first position preventing flow of fluid being exhausted from said boom jack means to a low pressure side of said circuit means and a second position permitting such flow, and means operatively connecting said implement to said second control valve means to automatically dispose the latter in said first and second positions thereof, respectively, with said implement in a position away from and in said predetermined position thereof, said last-named means comprising means to accommodate further movement of said implement from said predetermined position thereof after said second control valve means has been moved to said first position thereof.

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