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[54] **HYDRAULIC SYSTEM FOR A LOADER**

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[63] Continuation of Ser. No. 836,283, June 25, 1969, abandoned.

[52] **U.S. Cl.** **214/762,** 214/776

[51] **Int. Cl.** **E02f 3/86**

[58] **Field of Search** 214/762, 779, 778, 771, 214/138, 764; 91/412

[56] **References Cited**

UNITED STATES PATENTS

3,339,763 9/1967 Caywood ..... 214/138 R

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[57] **ABSTRACT**

A hydraulic system for a loader having a typical lift arm and a typical bucket pivotally mounted from the lift arm, and which hydraulic system includes in the principal embodiment three pumps, valves and related conduits for directing the hydraulic fluid in such a manner that when the lifting load resistance is above normal during lifting movement of the lift arm, the fluid first automatically causes a roll back motion of the bucket to try to relieve the abnormal resistance and then, if not relieved, the fluid causes the transmission disconnect to function to disconnect the power of the engine from the loader's wheels or tracks to stop the movement of the loader. A shuttle valve is provided in the circuit to prevent "chattering" during the bucket dumping operation. In addition, this system includes a steering control arrangement whereby at low speeds of the engine, the output from two of the pumps will flow to the steering valve and at higher speeds the output from one of these two pumps will be directed to a pilot operated valve where the pressure is utilized in combination with the third pump in the implement circuit. A second embodiment is disclosed which utilizes only two pumps and the steering arrangement is not in combination therewith.

15 Claims, 5 Drawing Figures

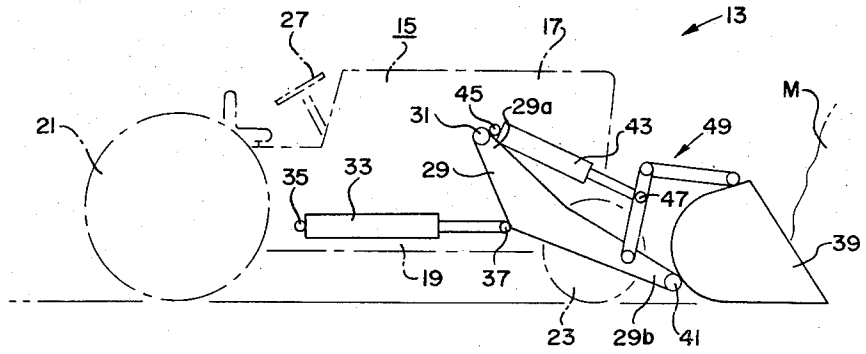
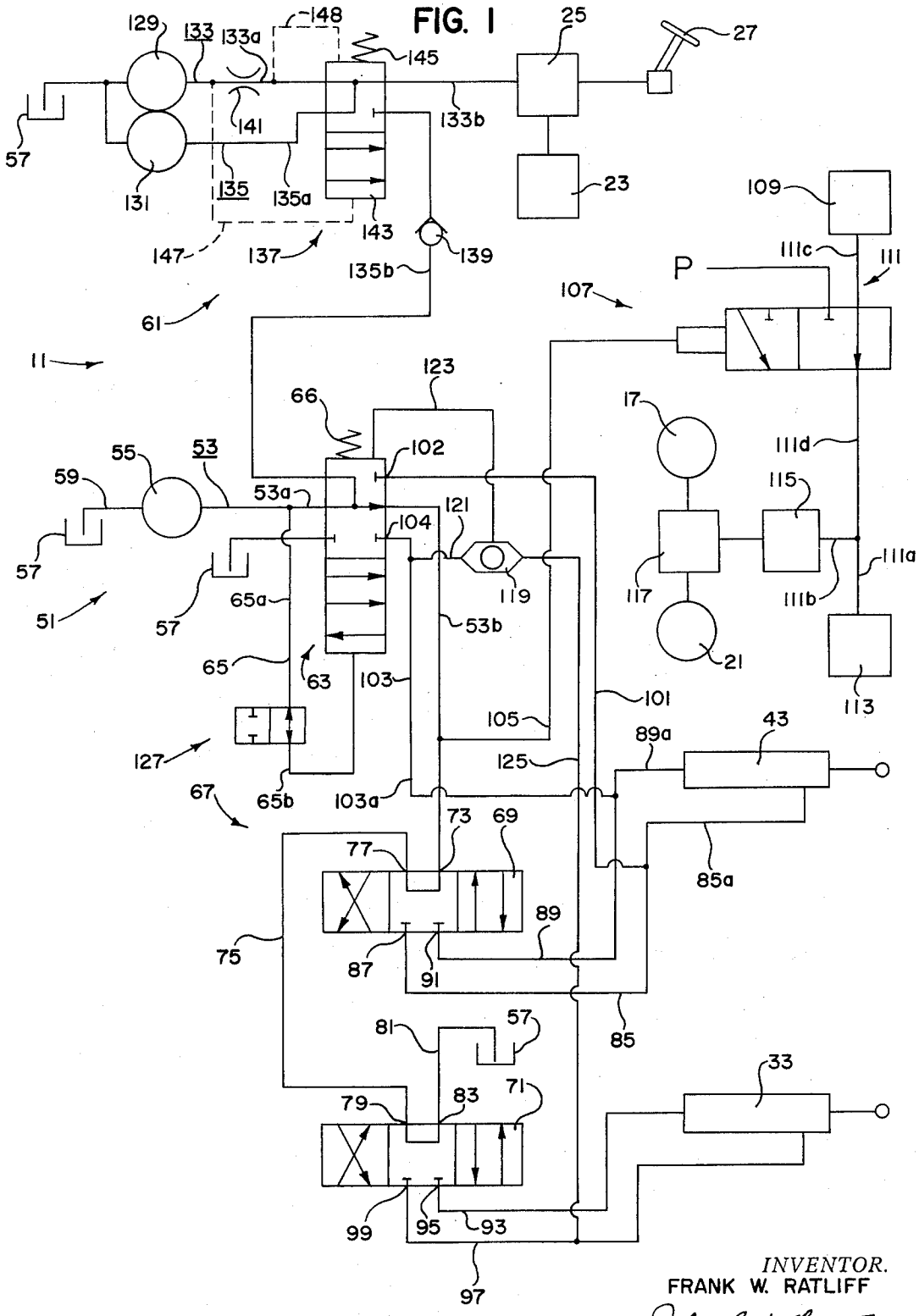


FIG. 1



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FIG. 2

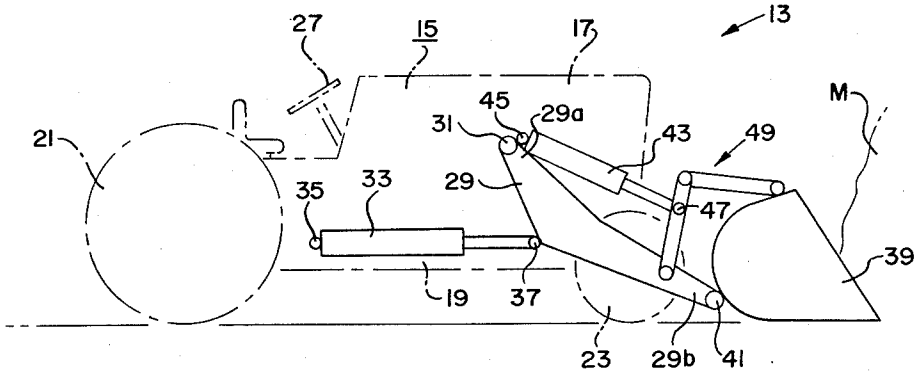


FIG. 3

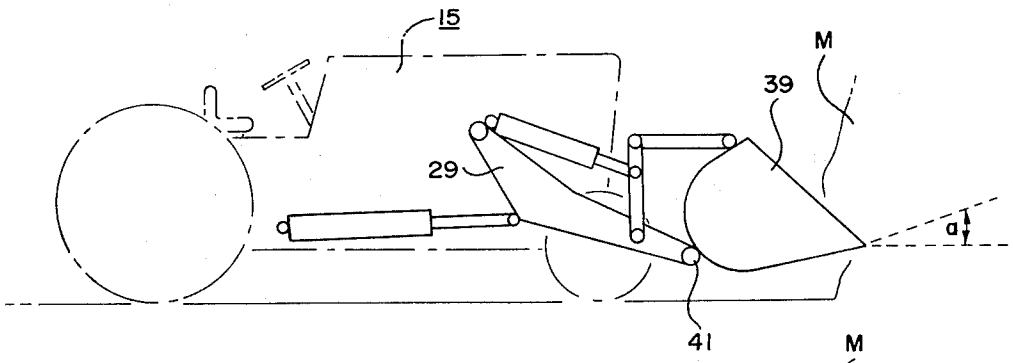
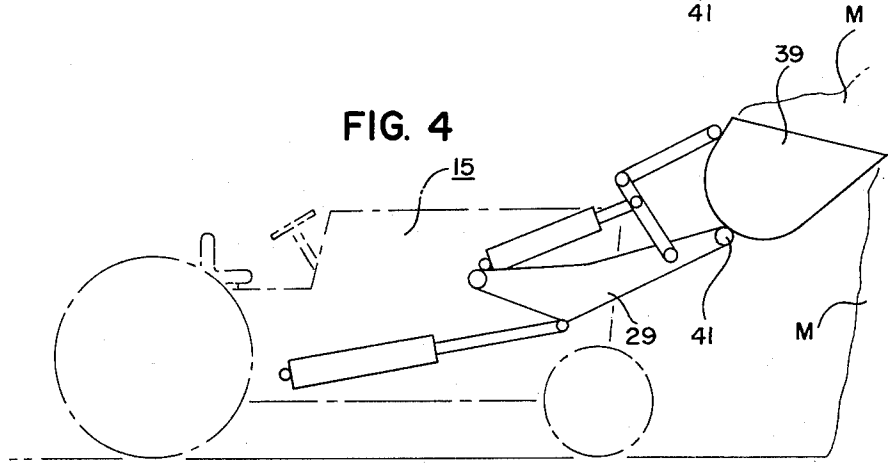


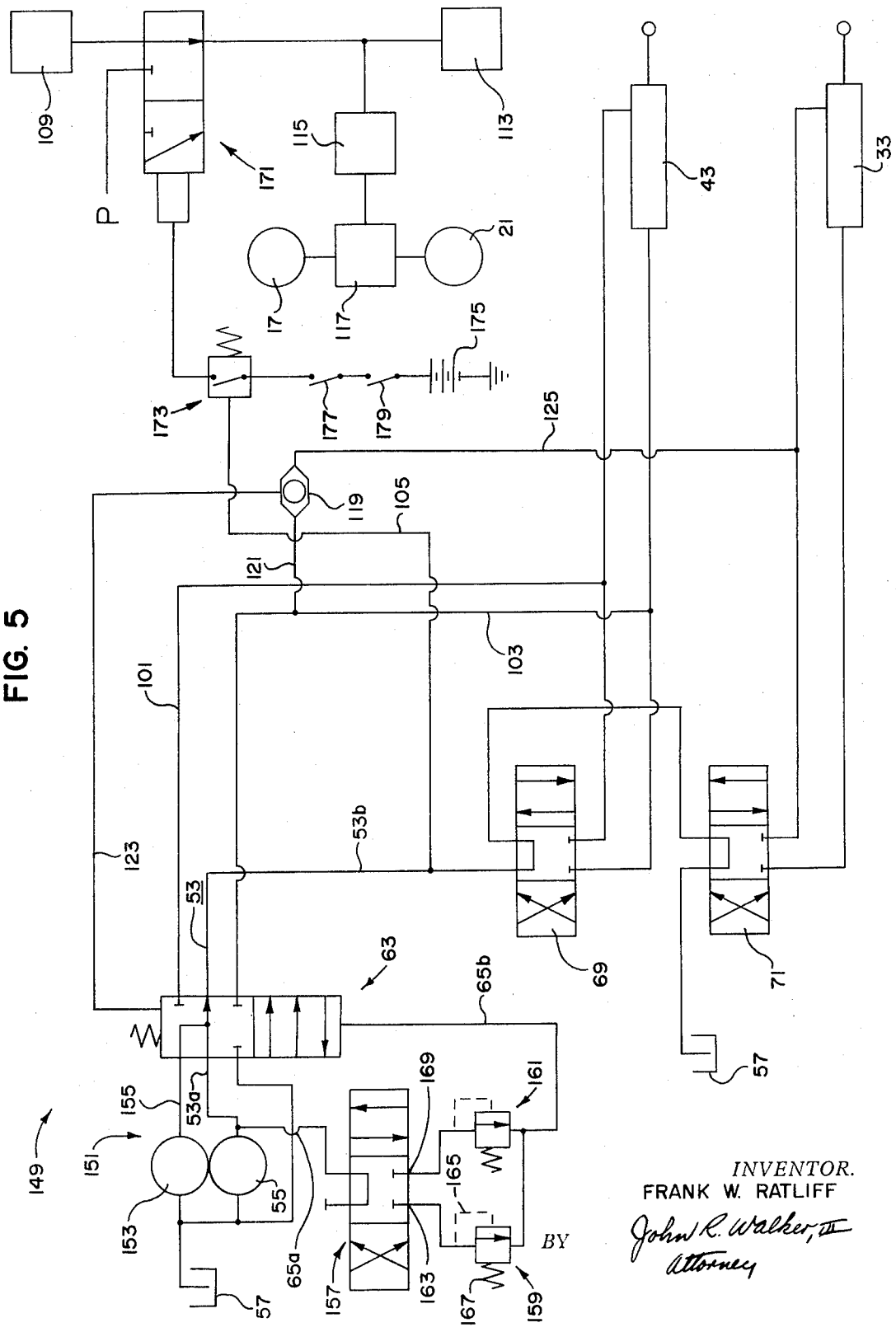
FIG. 4



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FIG. 5



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HYDRAULIC SYSTEM FOR A LOADER

The present application is a continuation of my prior application Ser. No. 836,283 filed June 25, 1969, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates to hydraulic systems for loaders.

2. Description of the Prior Art:

The usual manner in which an operator loads the bucket of a loader is by manual manipulation of the controls and the sequence is as follows: First, the operator loads the bucket by lowering the lift arms, leveling the bucket, and driving into the material as shown in FIG. 2 of the drawings. The operator will continue to drive into the material and actuate the manual control valve to start the lift arms up. The lifting force will be large due to the ground contact angle "*a*" causing the bucket to scrape the material bank. The operator can relieve this large lifting force by actuating the bucket portion of the manual control valve and cause the bucket to roll back, as shown in FIG. 3. The bucket roll back will improve the ground attack angle and will usually reduce the large lifting force. If the bucket roll back does not relieve the overload condition, the operator will stop the forward movement of the machine. This relieves the overload because the bucket is no longer forced horizontally into the material. The operator observes the machine for overload conditions and performs the above operations until the bucket is full, as shown in FIG. 4. There have been various hydraulic system arrangements for automatically leveling the bucket during the loading cycle and for repositioning the bucket of a loader after dumping. For example, the following U.S. Pats. relate in general to such arrangements: No. 2,978,124; No. 3,120,314; and No. 3,220,580. However, to my knowledge, no loader has heretofore been contemplated to monitor for overload conditions and correct in the same manner as an operator would manually relieve the overload conditions.

SUMMARY OF THE INVENTION

The present invention is directed towards providing a hydraulic system in a loader which allows the loader to load automatically the bucket without assistance from the operator. The present system monitors for overload conditions and causes the loader to function in a similar manner as an operator would manually relieve the overload conditions. Said system parallels a manual portion of a loader hydraulic circuit and, therefore, the operator can "take command at any time." In addition, if desired, a manual switch can be selectively actuated to lock out said system so that the operator must manually control the machine.

It is a concept of the present invention to provide a highly effective and relatively simple hydraulic system in which there is smooth operation and hydraulic power is provided in the particular places in the system where needed and at the proper time. Applicant accomplishes this concept by providing a pair of hydraulic fluid delivery means, namely, first and second fluid delivery means for supplying hydraulic fluid under pressure. In addition, means is provided for selectively directing fluid under pressure from both the first and second fluid delivery means to the lift cylinder to cause

the lift arms to move in a lifting direction when the fluid pressure in the lift cylinder is below a predetermined amount and for directing the hydraulic fluid from the first fluid delivery means to the lift cylinder and the hydraulic fluid from the second fluid delivery means to the bucket cylinder to cause the bucket to move in a roll back motion when the fluid pressure in said lift cylinder is above a first predetermined amount due to an above normal load on the bucket. In addition, means is provided for actuating the transmission disconnect means to disconnect power from the engine responsive to the pressure in the lift cylinder being above a second predetermined amount greater than the first predetermined amount. Also, shuttle valve means is included for preventing "chattering" during bucket dumping operations.

In the principal or first embodiment of the invention, said second fluid delivery means includes a pair of pumps and steering control means. At least one of the pumps is coupled to the engine for driving the pump proportionally to the speed of the eingine whereby the flow of the pump is proportional to the speed of the engine. In addition, second pilot operated control valve means is coupled to said pair of pumps for blocking fluid flow to the implement circuit from said pair of pumps and directing it to the steering valve when said second pilot operated control valve means is in a first condition and for directing fluid under pressure from one of said pumps to the implement circuit and for directing the fluid flow from the other of the pumps to the steering valve when the pilot operated control valve is in a second condition, and means responsive to fluid flow from said one of the pumps for actuating said second pilot operated control valve to said first condition when the engine speed is below a predetermined speed and for actuating said second pilot operated valve to said second condition when the engine speed is above a predetermined speed.

In the second embodiment of the invention, said second fluid delivery means comprises a single pump means.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of the first or preferred embodiment of the hydraulic system of the present invention and the related parts of a loader to which the hydraulic system is coupled.

FIGS. 2 – 4 illustrate the loading action of a typical loader with which the hydraulic system of the present invention is adapted to be utilized.

FIG. 5 is a schematic diagram of the second embodiment of the hydraulic system of the present invention and the related parts of the loader to which the hydraulic system is coupled.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to the preferred, or first, embodiment shown in FIG. 1, the hydraulic system 11 thereof is adapted to be used with a typical loader, as loader 13 shown in FIGS. 2 – 4. Loader 13 typically includes a vehicle or tractor 15 having the usual engine 17, mounted on a chassis or frame 19, suitable ground engaging means for moving the vehicle 15 such as crawlers, not shown, or wheels 21, 23, the usual steering valve 25 coupled to the steerable ground engaging means as the front wheels 23 or to an articulated vehicle of the well

known type such as that shown in U.S. Pat. No. 3,360,925, and a steering means as the steering wheel 27 coupled to steering valve 25 in a known manner to direct the hydraulic fluid flow to the steering rams, not shown, to cause steering of the vehicle 15. Other suitable components typically found on a loader may be provided. In addition, loader 13 includes the usual pair of lift arms 29 (only one of which is shown) each pivotally mounted adjacent the inner end 29*a* thereof as at 31 from loader 13 on either side thereof. A ram or lift cylinder 33, provided for each lift arm 29, is pivotally attached to a suitable portion on the loader as at 35 and pivotally attached adjacent the other end as at 37 to a lift arm 29 so that retraction of lift cylinders 33 causes downward pivoting of the lift arm and extension of the lift cylinders 33 causes upward pivoting of the lift arms. A bucket 39 is pivotally attached as at 41 to each lift arm 29 adjacent the outer or distal end 29*b* thereof. A pair of bucket cylinders 43 (only one of which is shown) are provided with each being pivotally attached at one end as at 45 to a lift arm 29 and being pivotally attached at the opposite end thereof as at 47 to a typical linkage mechanism 49 for pivoting bucket 39 in a curled back motion or disposition (counterclockwise as viewed in FIGS. 2 – 4) when cylinder 43 is retracted and for pivoting the bucket in a downwardly or dumping motion or disposition (clockwise as viewed in FIGS. 2 – 4) when cylinder 43 is extended.

Hydraulic control system 11 includes a first fluid delivery means 51 including a first conduit 53 and means providing fluid under pressure thereto, which preferably includes a first pump 55 receiving hydraulic fluid from tank 57 through the supply conduit 59. Pump 55 is of any suitable type, such as a gear pump, coupled to and driven by engine 17 by suitable means, not shown. A second fluid delivery means 61 is provided which will be described in more detail later in the specification. A first pilot operated control valve 63 is provided which is interposed in first conduit 53 to divide the conduit into a first part 53*a* upstream of the valve 63 and a second part 53*b* downstream of the valve. Valve 63 senses the pressure in first conduit 53 through the line 65 and is operative in two positions depending upon the pressure in first conduit 53. Thus, when the pressure in first conduit 53 is below a predetermined amount, the valve 63 will be shifted into a first position or condition shown in FIG. 1 by spring 66 acting at the end of the valve, and when the pressure in conduit 53 is above a first predetermined amount, valve 63 will shift into a second position or condition so that the lower portion of the valve 63 as viewed in FIG. 1 is in line with the ports of the valve. When valve 63 is in said first position, the fluid from second fluid delivery means 61 will be directed by the valve to first conduit 53 and the fluid from first pump 55 will flow through first conduit 53 so that the output from the combined first and second hydraulic delivery means 51, 61 will be provided in first conduit 53. First conduit 53 leads to the manual control valve means 67 for directing the hydraulic fluid to the bucket cylinder 43 and lift cylinder 33. Manual control valve means 67 is of any suitable construction and preferably as shown in FIG. 1, wherein there are two three-way valves, a control valve 69 for bucket cylinders 43 and a control valve 71 for lift cylinders 33. As heretofore stated, there are preferably a pair of cylinders 33 and a pair of cylinders 43, but for the sake of clarity and simplicity only one of each has been shown in FIG. 1. It will be understood that the other one of cylinders 33, not shown, is connected in parallel with the one shown, and similarly the other one of cylinders 43, not shown, is connected in parallel with the cylinder 43 which is shown, so that the two cylinders 33 operate in unison and the two cylinders 43 operate in unison.

The arrangement of the various conduits are preferably as follows: First conduit 53 connects to a port 73 on valve 69. A conduit 75 leads from a port 77 on valve 69 to a port 79 on valve 71. A conduit 81 leads from port 83 on valve 71 to tank 57. A conduit 85 leads from a port 87 of valve 69 to the front or rod end of bucket cylinder 43. A line 89 leads from a port 91 of valve 69 to the base end of bucket cylinder 43. A line 93 leads from a port 95 of valve 71 to the base end of lift cylinder 33 and a line 97 leads from a port 99 of valve 71 to the front or rod end of lift cylinder 33. From the foregoing, it will be understood that when valves 69, 71 are in the center positions shown in FIG. 1, the bucket and lift cylinders 43, 33 will be held in a fixed position and the oil pressure from first conduit 53 will be returned to the tank 57 through the conduits 75, 81. Also, it will be understood that when valve 71 is shifted to cause the left end of the valve, as viewed in FIG. 1, to line up with the ports 79, 99 and 83, 95, the fluid will flow through the valve, through the line 93 and cause the lift cylinder to extend and the lift arm 29 to be moved in a digging disposition. Also, it will be understood that when the right end of the valve 71 is moved into alignment with the ports, the lift arm 29 will be caused to move in a lowering movement. When valve 69 is moved so that the left end of the valve is in alignment with the ports 77, 87 and 73, 91, the hydraulic fluid from first conduit 53 will be directed by the valve through the line 85 to the front or rod end of the bucket cylinder 43 to retract the bucket cylinder 43 to cause a so-called "roll back" motion or disposition of the bucket 39, that is, the bucket will pivot about the pivot point 41 counterclockwise as viewed in FIGS. 2 – 4. Then, when the right end of valve 69 is moved into position in alignment with the ports, the hydraulic fluid will be caused to move through the valve 69 and the line 89 to the base end of the bucket cylinder 43 to extend the cylinder and cause bucket 39 to move in a clockwise or unloading motion.

A second conduit 101 leads from an outlet port 102 of first pilot operated control valve 63 to the rod end of bucket cylinder 43 through a portion 85*a* of line 85. A line 103 leads from port 104 of valve 63 to the base end of cylinder 43 through a portion 89*a* of line 89. A line 105 leads from line 53 to a pressure responsive valve 107, which is a two position valve with the first position thereof being shown in FIG. 1 and which is movable to a second position in which the left portion of the valve 107 is moved into alignment with the ports responsive to the pressure in lift cylinder 33 being above a second predetermined amount, which is greater than said first predetermined amount required to move first pilot operated control valve 63 into said second position. Pressure responsive valve 107 is connected into the typical pedal actuated arrangement found in loaders whereby the operator may manually push down on a pedal, not shown, to actuate the usual brake valve 109 which causes fluid to be transmitted through the line 111 into the branches 111*a* and 111*b* thereof to the usual master cylinder 113 and transmis-

sion disconnect 115, respectively. Transmission of the above mentioned pressure to the master cylinder 113 causes the brakes to be applied, and transmission of the above mentioned pressure to transmission disconnect 115 causes the usual transmission 117 to disconnect the power from the engine 17 to the drive wheels 21. Valve 107 is interposed in line 111 of the above described usual arrangement to divide the line 111 into two parts 111*c* and 111*d*. When valve 107 is in said first position, the parts above described work in the usual manner by application of the operator's foot on the pedal, but when the pressure in line 53 is greater than said second predetermined pressure, then the valve 107 shifts to said second position so that the brakes are automatically applied and the power is automatically disconnected from the wheels 21.

A shuttle valve 119 is provided in connection with first pilot operated valve 63 so that when bucket 39 is being moved in dumping motions, the valve 63 is locked in said first position which prevents chattering during the dumping cycle of the bucket 39. More particularly, one end of shuttle valve 119 is coupled to the base end of bucket cylinder 43, through line 121, through a portion 103*a* of line 103, and through a portion 89*a* of line 89. Thus, when there is high pressure on the base end of bucket cylinder 43 (when bucket 39 is being dumped), the high pressure causes the shuttle valve 119 to block flow from line 123, which leads from one end of the valve 63, and locks the valve in said first position thereof. The other end of shuttle valve 119 is connected through a line 125 to conduit 97 so that when lift arms 29 are lowered under pressure, bucket 39 will not curl. In other words, shuttle valve 119 is an "or" valve which blocks the flow from line 123 if there is high pressure in the base end of bucket cylinder 43 "or" the rod end of lift cylinder 33.

A two-position valve 127 is provided in line 65 to lock the automatic system of the present invention out, if desired, by switching the valve 127 from the first position shown in FIG. 1 to the second position in which the left portion of the valve blocks the flow through line 65. The line 65 is divided into two portions, namely, portion 65*a* and 65*b* by the valve 127.

Second fluid delivery means 61 includes a pair of pumps, namely, a second pump 129 and a third pump 131, both of which are preferably similar to first pump 55. Both pumps 129, 131 are preferably coupled to and driven by engine 17 so that the flow output in the respective conduits leading therefrom, namely, third conduit 133 and fourth conduit 135 are respectively proportional to the speed of engine 17. It will be understood that pumps 129, 131 may be either two separate pumps, or a double pump with two pump sections on the same shaft, or, if desired, any two other means for providing fluid under pressure to the respective conduits 133, 135 proportional to the speed of the engine 17.

Second hydraulic fluid delivery means 61 also includes a second pilot operated control valve 137 interposed in the respective conduits 133, 135 to divide the conduits into the respective portions 133*a*, 133*b* and 135*a*, 135*b*. Portion 133*b* leads from valve 137 to steering valve 25. Portion 135*b* leads from valve 137 to first pilot operated control valve 63. A check valve 139 is provided in portion 135*b* to prevent backflow of fluid from first pilot operated control valve 63 towards second pilot operated control valve 137. When second pilot operated control valve 137 is in a first position or condition, shown in FIG. 1, the valve directs fluid under pressure to steering valve 25 from both of the pumps 129, 131, and when valve 137 is in a second position or condition in which the lower portion of the valve is in alignment with the ports, the valve directs fluid under pressure from only pump 129 to steering valve 25 and the fluid under pressure from pump 131 to first pilot operated control valve 63 through fourth conduit 135. Means, preferably in the form of a restriction 141 in third conduit 133 (preferably in the portion 133*a* thereof) and means for applying the pressure differential across the restriction to the opposite ends of the spool 143 of valve 137, is provided so that the output fluid flow from pump 129 actuates valve 137 to said second condition when the output fluid flow from pump 129 is above a predetermined amount (when engine 17 reaches a predetermined speed) and so that the control valve 137 is actuated to said first condition when the output fluid flow from pump 129 is below a predetermined amount (when the speed of engine 17 is below a predetermined speed). More specifically, the above mentioned valve 137, restriction 141 and the related parts are as follows: Valve 137 includes a spring 145 at one end of the valve urging spool 143 toward said first position. A line 147 leads from conduit 133 at a point upstream of restriction 141 to one end of spool 143 opposite from spring 145 to urge the spool in a direction opposite from the spring 145. A line 148 leads from conduit 133 at a point downstream of restriction 141 to the opposite end of spool 143 from conduit 147 to urge the spool in the same direction as spring 145 so that when the pressure on the spool from conduit 147 is less than the combined pressure on the spool from conduit 148 and spring 145, the spool will be moved toward said first position and when the pressure on the spool from conduit 147 is greater than said combined pressures, the spool will be moved toward said second position.

From the foregoing, it will be seen that the operation of the hydraulic control system 11 is such that adequate oil flow is maintained to the steering valve 25 while the speed of the engine 17 is slow. That is, when the engine speed is slow, the fluid from both pumps 129, 131 is delivered to the steering valve 25. Then, as the speed of the engine 17 increases to a predetermined point, which would otherwise cause the steering to be too fast for safe operation of the vehicle 15 were it not for the hydraulic control system of the present invention, the pressure drop across the restriction 141 becomes greater and is transmitted to the spool 143, as heretofore described, to shift the spool to said second condition to cause only the flow from pump 129 to be delivered to the steering valve 25 and the flow from pump 131 to be delivered to first pilot operated control valve 63. At valve 63 this flow from pump 131 is combined with the flow from pump 55 when first pilot operated control valve 63 is in said first position and supplied to first conduit 53 of the implement circuit.

In describing the operation of the implement circuit, it is assumed that the lift arm 29 is at a given position for loading, as for example, in the position shown in FIG. 2 and has been put in this position manually by operating the control valve 71, and bucket 39 is at a given angle relative to lift arm 29, as for example, at the angle shown in FIG. 2 and has been positioned in this angle by manually manipulating the control valve 69, and the

operator is causing the vehicle 15 to be driven into the material M shown in FIG. 2. The operator will continue to drive into the material M and actuate the manual control valve 71 so that the left portion of the valve spool is in alignment with the ports to start the lift arms 29 upwardly. The lifting force will be large due to the ground contact angle "*a*" causing the bucket 39 to scrape the material bank. When this lifting force increases, the pressure in line 93 increases which is felt in line 75 and conduit 53, which in turn is transmitted to the lower end of pilot operated valve 63 through the line 65 to cause the valve 63 to move into said second position against the force of spring 66 at the opposite end of the valve. Movement of valve 63 into said second position causes the flow from second fluid delivery means 61 to flow through valve 63, through second conduit 101, through the portion 85*a* of line 85 to the rod end of bucket cylinder 43 and cause "roll back" motion of the bucket 39. This "roll back" motion of the bucket 39 will cause some relief of the lifting forces, and if the relief is sufficient so that the pressure in the lift cylinder 33 drops below said first predetermined point, then first pilot operated control valve 63 drops back into said first position to combine the flow once again. However, if the above mentioned "roll back" of bucket 39 does not relieve the lifting forces sufficiently, and the pressure reaches a second predetermined point, the pressure in lines 105 and 53 which is caused by the pressure in lift cylinder 33 will cause shift of valve 107 to said second position. The shifting of valve 107 to said second position causes fluid to flow through the valve 107 from a suitable source of fluid pressure as P and into the part 111d of line 111 and divide into the branches 111*a* and 111*b* to respectively pressurize the brake cylinder 113 to cause applying of the brakes of the vehicle 15 and to pressurize the transmission disconnect 115 to cause power to be disconnected from the wheels 21. The loader 13 no longer holds the bucket 39 into the material M and the pressures in the lift and bucket cylinders 33, 43 are lowered, the transmission 117 once again connects the engine 17 to the wheels 21 and the valve 63 slides down to cause the combined flow from pump 131 and pump 55 to flow to the lift cylinder. The cycle will start again when the lift pressure reaches the setting of valve 63.

Referring now to the system of FIG. 5 which will be designated system 149, it is somewhat similar to system 11 and like parts will be designated by like numerals. The primary difference between systems 149 and 11 are as follows: In system 149 the second hydraulic fluid delivery means 151, which corresponds to second hydraulic fluid delivery means 61 of system 11, is a single pump, namely, second pump 153 which is preferably coupled by suitable means to engine 17 and the output of which is delivered to first pilot operated control valve 63 through the conduit 155. In system 149 in place of the valve 127 of system 11, there is preferably added the following arrangement, which may be utilized in system 11, if desired, or valve 127 may be utilized, if desired, in system 149 in place of said following arrangement: A mode control three-way valve 157 is provided which is shiftable from a center or shut-off or locking mode shown in FIG. 5 to a first position or mode in which system 149 is set up to operate for a given set of conditions, as for example, in digging loose material, or to a second position or mode in which system 149 is set up to operate for another set of conditions, as for example, in digging hard bank material. A first pressure responsive valve 159 and a second pressure responsive valve 161 are provided. Valve 159 is communicated with the exit port 163 of valve 157 so that when valve 157 is shifted into said first position, the right portion of valve 157 is in alignment with the ports and the pressure in first conduit 53 is communicated to valve 159 and to the end of the valve through line 165. A spring 167 is provided at the opposite end of the valve against which the pressure in line 165 acts. If the pressure in line 165 is greater than a predetermined amount, as determined by the spring 167, valve 159 will shift from a first position as shown in FIG. 5 in which flow is blocked therethrough to a second position in which flow is permitted therethrough so that the fluid pressure is transmitted to the end of valve 63 to shift valve 63 in a manner heretofore described. Valve 161 is similar to valve 159 only it is set at a given pressure which is at a higher actuating pressure than valve 159. Valve 161 is communicated with the exit port 169 of valve 157 so that when valve 157 is shifted into said second position, in which the left portion of valve 157 is in alignment with the ports, pressure in first conduit 53 is communicated to valve 161. Then, with valve 157 in said second position, when the fluid pressure in first conduit 53 is at a high enough pressure to actuate valve 161 the pressure will be communicated to the end of valve 63 to shift valve 63 in a manner heretofore described. The pressures required to actuate valves 159, 161 are each preferably lower than that required to actuate a valve 173 (referred to hereinafter), and the actuating pressure of valve 159 is preferably lower than the actuating pressure of valve 161. In system 149, the valve 171, which corresponds to valve 107 of system 11, operates somewhat differently in that it is solenoid actuated by means of a pressure responsive electrical switch 173 which is closed by pressure being felt in line 105 just as in system 11. Closure of switch 173 causes valve 171 to move to a second position in which the pressure is applied to the transmission disconnect 115 and master cylinder 113 from the pressure source P. Suitable electric circuit means are provided for switch 173, such as the battery 175, suitable leads, the ignition switch 177, and the off-on switch 179. It will be noted that in system 149 there is no tie-in with the steering valve and no second pilot operated valve but other than this and the heretofore mentioned differences, systems 11 and 149 are similar and operate in the same manner.

I claim:

1. A hydraulic system for a loader including a vehicle, a lift arm pivotally mounted on said vehicle, a bucket pivotally mounted on said arm, ground engaging means for moving the vehicle, engine means, lift cylinder means for lifting said arm, and bucket cylinder means for rolling back said bucket relative to said lift arm; said system comprising a first hydraulic delivery means for supplying hydraulic fluid under pressure, a second hydraulic delivery means for supplying hydraulic fluid under pressure, first valve means for selectively directing fluid under pressure from both said first and second fluid delivery means to said lift cylinder means to cause said lift arm to move in a lifting direction when the fluid pressure in said lift cylinder means is below a predetermined amount and for directing the hydraulic fluid from said first delivery means to said lift cylinder means and the hydraulic fluid from said second fluid delivery means to said bucket cylinder means to cause

said bucket to move in a roll back motion when the fluid pressure in said lift cylinder means is above a first predetermined amount due to an above normal load on said bucket.

2. The hydraulic system of claim 1 in which is included means for controlling said first valve means to selectively change said predetermined amount.

3. The hydraulic system of claim 2 in which said means for controlling said first valve means includes means for locking said first valve means.

4. The hydraulic system of claim 1 in which is included in said loader, transmission means for selectively transmitting or disconnecting power from said engine means to said ground engaging means, and pressure responsive transmission disconnect means for actuating said transmission means to disconnect the power from said engine means to said ground engaging means, and in which is included in said system, means coupled to said transmission disconnect means to disconnect power from said engine responsive to the pressure in said lift cylinder means being above a second predetermined amount greater than said first predetermined amount.

5. The hydraulic system of claim 1 in which said second fluid delivery means includes a single pump means for pumping fluid.

6. The hydraulic system of claim 1 in which said second fluid delivery means includes a pair of pumps for pumping fluid, means coupling at least one of said pumps to said engine means for driving said one of said pumps proportionally to the speed of said engine means whereby the flow output of said one of said pumps is proportional to the speed of said engine means, second valve means coupled to said pair of pumps for blocking fluid flow to said first valve means from said pumps when said second valve means is in a first condition and for directing fluid under pressure from one of said pumps to said first valve means when said second valve means is in a second condition, and means responsive to fluid from from said one of said pumps for actuating said second valve means to said first condition when said engine means speed is below a predetermined speed and for actuating said second valve means to said second condition when said engine means speed is above a predetermined speed.

7. The hydraulic system of claim 4 in which said loader includes a steering valve means for controlling the steering of the loader and in which said system includes means for coupling said second valve means to said steering valve means to direct fluid to said steering valve means from both of said pumps when said second valve means is in said first condition.

8. A hydraulic system for a loader including a vehicle, a lift arm pivotally mounted on said vehicle, a bucket pivotally mounted on said arm, ground engaging means for moving the vehicle, engine means, transmission means for selectively transmitting or disconnecting power from said engine means to said ground engaging means, pressure responsive transmission disconnect means to disconnect power from said engine means, lift cylinder means for lifting said lift arm, bucket cylinder means for rolling back said bucket relative to said lift arm, steering valve means for controlling the steering of the loader, and a first control valve means for directing fluid to said lift cylinder means for movement of said lift arm in lifting motions; said system comprising a hydraulic fluid source, a first pump and a first conduit for supplying hydraulic fluid under pressure from said source to said first control valve means, first pilot operated valve means shiftable between a first condition responsive to the hydraylic pressure in said first conduit being below a predetermined amount when the forces acting on said lift arm are normal and a second condition responsive to hydraulic pressure in said first conduit being above a predetermined amount due to loading resistance above a predetermined amount being felt in said lift cylinder means, a second conduit leading from said first pilot operated valve means to said bucket cylinder means, a second fluid delivery means for delivering fluid under pressure from said source to said first conduit when said first pilot operated valve means is in said first condition and for delivering fluid under pressure to said second conduit for causing roll back movement of said bucket when said first pilot operated valve is in said second condition, means for delivering fluid pressure to said transmission disconnect means to disconnect power from said engine responsive to the pressure in said lift cylinder means being above a predetermined amount.

9. The hydraulic system of claim 8 in which is included means for controlling said first pilot operated valve means to selectively change said predetermined amount.

10. The hydraulic system of claim 8 in which said second fluid delivery means comprises a second pump, a third pump, a second pilot operated valve means selectively shiftable in a first condition in which the flow from said second and third pumps is directed to said steering valve means and in a second condition in which the flow from said second pump is directed to said steering valve means and the flow from said third pump is directed to said first pilot operated valve means, a third conduit having a portion leading from said second pump to said second pilot operated valve means and a portion leading from said second pilot operated valve means to said steering control valve, a fourth conduit having a portion leading from said third pump to said second pilot operated valve means and a portion leading from said second pilot operated valve means to said first pilot operated valve means, means coupling said first, second and third pumps to said engine means for driving said pumps proportionally to the speed of said engine means whereby the flow output of said pumps is proportional to the speed of said engine means, restriction means in said third conduit to provide a pressure differential across said restriction means proportional to the speed of said engine means, means communicating said pressure differential to said second pilot operated valve means for the shifting thereof respectively to said first and second conditions at predetermined speeds of said engine means.

11. The hydraulic system of claim 10 in which is included shuttle valve means for locking said first pilot operated valve means in said first condition during bucket dumping operations.

12. The hydraulic system of claim 11 in which means is included for selectively locking at any time said first pilot operated valve means in said first condition.

13. A hydraulic system for a loader including a vehicle, a lift arm pivotally mounted on said vehicle, a bucket pivotally mounted on said arm, ground engaging means for moving the vehicle, engine means, brake means, and transmission disconnect means for causing selective transmission or disengagement of power from

said engine means to said ground engaging means, lift cylinder means for lifting said lift arm, bucket cylinder means for roll back movement of said bucket relative to said lift arm, and manual control valve means for directing hydraulic fluid to said bucket cylinder means, and for directing hydraulic fluid to said lift cylinder means; said system comprising a first hydraulic fluid delivery means for supplying hydraulic fluid under pressure, a second hydraulic fluid delivery means for supplying hydraulic fluid umder pressure, first valve means coupled to said first and second fluid delivery means for directing fluid under pressure from both of said first and second fluid delivery means to said manual control valve means when said first valve means is in a first condition and for directing fluid under pressure from said first fluid delivery means to said manual control valve means and from said second fluid delivery means to said bucket cylinder means to cause roll back movement of said bucket when said first valve means is in a second condition, means responsive to the hydraulic pressure in said lift cylinder means during lifting above a predetermined amount due to an above normal load on said bucket for actuating said first valve means to said second condition and responsive to the hydraulic pressure in said lift cylinder means during lifting being below a predetermined amount for actuating said first valve means to said first condition, and means responsive to the pressure in said lift cylinder means being above a predetermined amount for actuating said transmission disconnect means to disengage power from said ground engaging means and for actuating said brake means.

14. A hydraulic system for a loader including a vehicle, a lift arm pivotally mounted on said vehicle, a bucket pivotally mounted on said arm, ground engaging means for moving the vehicle, engine means, lift cylimder means for lifting said lift arm, and bucket cylinder means for roll back movement of said bucket relative to said lift arm, steering valve means for controlling the steering of the loader, and a first control valve directing fluid to said lift cylinder means for movement of said lift arm in lifting motions; said system comprising a first hydraulic delivery means for supplying hydraulic fluid under pressure, a second hydraulic delivery means for supplying hydraulic fluid under pressure, first pilot operated valve means for selectively directing fluid under pressure from both said first and second fluid delivery means to said lift cylinder means to cause said lift arm to move in a lifting direction when the fluid pressure in said lift cylinder means is below a first predetermined amount and for directing hydraulic fluid from said first delivery means to said lift cylinder means and the hydraulic fluid from said second fluid delivery means to said bucket cylinder means to cause said bucket to move in a roll back movement when the fluid pressure in said lift cylinder means is above said first predetermined amount due to an above normal load on said bucket; said second fluid delivery means comprising a second pump, a third pump, a second pilot operated valve means selectively shiftable in a first condition in which the flow from said second and third pumps is directed to said steering valve means and in the second condition in which the flow from said second pump is directed to said steering valve means and the flow from said third pump is directed to said first pilot operated valve means, a third conduit having a portion leading from said second pump to said second pilot operated valve and a portion leading from said second pilot operated valve means to said steering valve means, a fourth conduit having a portion leading from said third pump to said second pilot operated valve means and a portion leading from said second pilot operated valve means to said first pilot operated valve means, means coupling said first, second and third pumps to said engine means for driving said pumps proportionally to the speed of said engine means whereby the flow output of said pumps is proportional to the speed of said engine means, restriction means in said third conduit to provide a pressure differential across said restriction means proportional to the speed of said engine means, and means communicating said pressure differential to said second pilot operated valve means for the shifting thereof respectively to said first and second conditions at predetermined speeds of said engine.

15. The hydraulic system of claim **14** in which is included in said loader, transmission means for selectively transmitting or disconnecting power from said engine means to said ground engaging means, and pressure responsive transmission disconnect means for actuating said transmission means to disconnect the power from said engine to said ground engaging means and in which is included in said system, means for delivering fluid pressure to said transmission disconnect means to disconnect power from said engine responsive to the pressure in said lift cylinder means being above a second predetermined amount greater than said first predetermined amount.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,796,336 Dated March 12, 1974

Inventor(s) Frank W. Ratliff

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 4, "hydraylic" should read --hydraulic--.

Column 11, line 37, "cylimder" should read --cylinder--.

Column 11, line 40, insert after "valve" --means for--.

Signed and sealed this 23rd day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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