March 22, 1966 C. O. PEDERSEN 3,241,694

LOADER AND TRACTOR MECHANISM

Filed Oct. 1, 1964 3 Sheets-Sheet 1

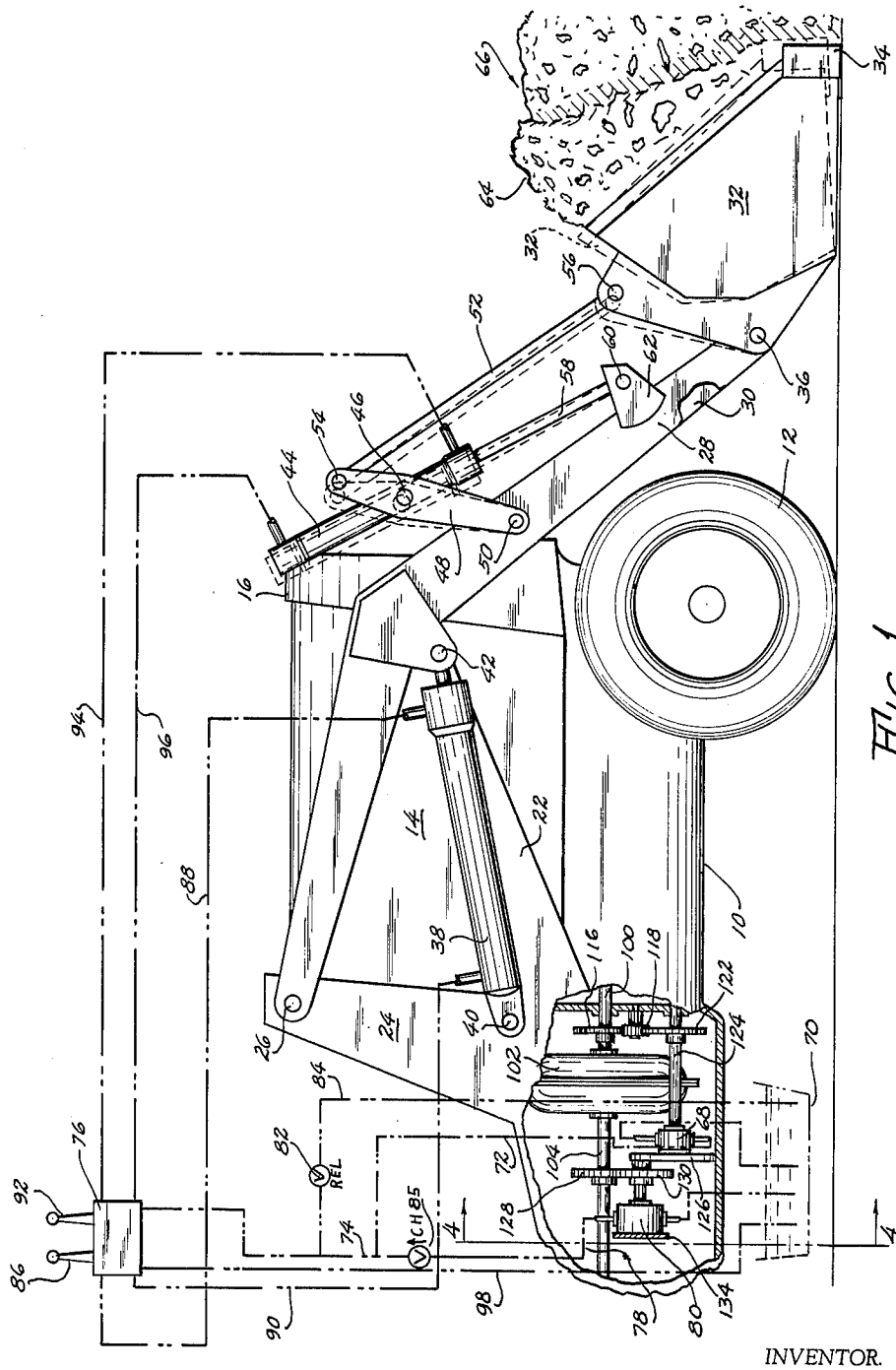


FIG. 1

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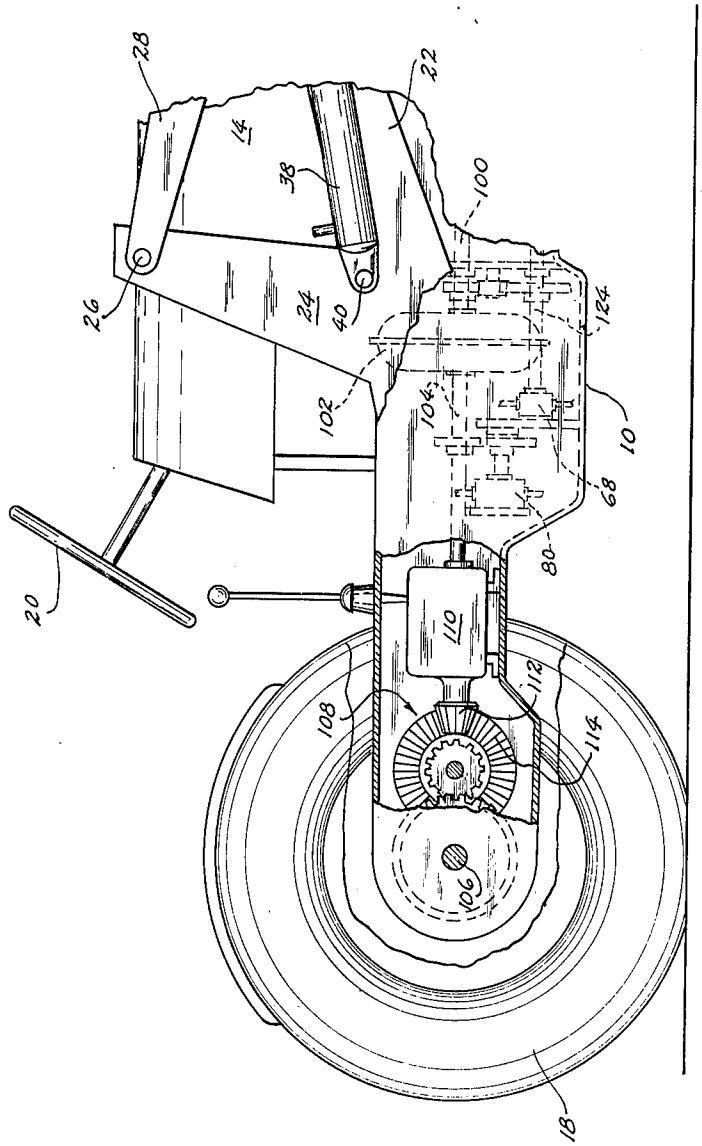


FIG. 2

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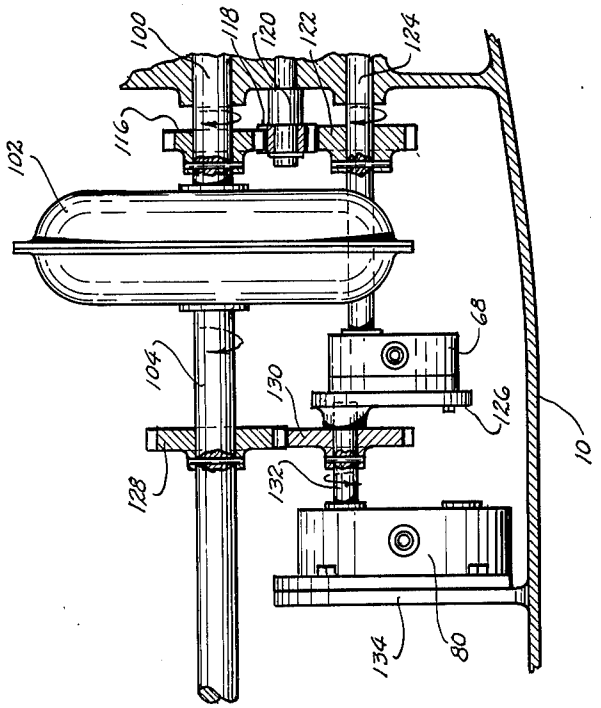


FIG. 3

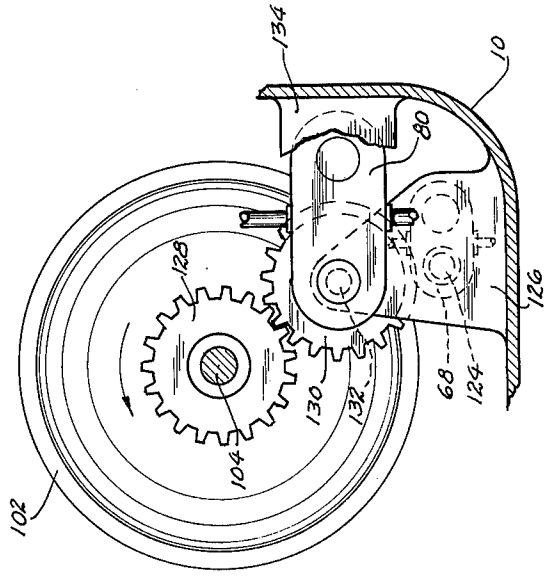


FIG. 4

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LOADER AND TRACTOR MECHANISM

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15 Claims. (Cl. 214—140)

The present invention relates to tractor mechanism, and an object is to generally improve the construction and operation of mechanism of this class. Tractors, of course, are used for many different purposes, and the present invention relates to a tractor particularly as adapted to earth moving, and equipment to form what is known in the trade as a tractor loader, in which a shovel or bucket is mounted on the front of the tractor to be raised and lowered by an appropriate mechanism, and also to be tilted as required, into the correct attitude for the work being performed at the moment. Such adjustments of the bucket are commonly made by hydraulic cylinders or motors supplied with pressure fluid from a suitable source, and the invention deals generally with this source of fluid pressure.

Commonly, a suitable pump is driven from the mechanism of the tractor and supplies the fluid under pressure, the excess being discharged through a suitable relief valve. While such systems have been reasonably satisfactory, they have left something to be desired, and it is to avoid or remedy certain defects that the present invention has been devised. The pump, if it varies in speed, delivers a varying volume of fluid, and with the common arrangement of the tractor engine which runs at a governed speed, the pump, if run from the engine directly, will always pump its maximum amount of fluid, regardless of the needs of the moment, and therefore use or absorb from the engine, the full amount of power of which the pump is capable. This is an appreciable amount of power, and much of the time such full volume of fluid is not necessary. The greater part of the power being absorbed is merely wasted in heating the pressure fluid, and incidentally causing unnecessary wear in the relief valve.

One expedient to help this situation would be to run the pump from a portion of the usual transmission so that its speed will vary generally with the rate of movement of the tractor. This arrangement in a tractor loader has serious disadvantages in the usual operation of a tractor loader.

A common mode of operation of this type of loader is to drive the tractor with the bucket sliding along the ground into a pile of material until the resistance of the bucket going into the pile stops the movement of the tractor. Under these conditions, the traction elements are stopped, as also is the power output element of the usual transmission. If the pump is driven from this output element, it also stops and there is no fluid pressure available for adjusting the bucket. However, at this time, it is desirable to have a high pressure available for a limited upward tilting of the bucket to break a portion of the material loose from the rest of the pile, so such an arrangement would seriously handicap the device for this type of service. The solution of this difficulty would be to pump the fluid at a varying rate in relation to the engine speed.

If it were possible to pump the fluid at a rate which was a compromise between the engine speed and the speed of the output element of the transmission, the above difficulties would be avoided, and certain advantages would be realized, particularly under the type of operation just described.

The fluid, at times when the tractor was stopped by the aforesaid pile of material, would be pumped in considerably less volume, and therefore use or actually waste substantially less power than if it were being pumped in high volume. However, it could still be pumped in sufficient volume to supply ample pressure to perform the break-out operation, particularly since a large volume of fluid is not needed under these conditions. Accordingly, the principal object of the invention is to provide a dual pump arrangement for pumping a volume of fluid which will absorb a minimum amount of power under stalling conditions, but which arrangement will pump a higher volume of fluid under most other conditions, to deliver the necessary larger volume of fluid which is then needed.

Further objects and advantages will be apparent from the following specification, and the annexed drawings, in which:

FIGURE 1 is a side elevation, partly diagrammatic in character, of so much of a tractor loader as is necessary to illustrate the invention, parts being broken away to show what lies beneath, and others omitted to avoid complication of the drawing;

FIG. 2 is a side elevation with parts broken away, showing the traction means;

FIG. 3 is an enlarged plan view of the two-pump hydraulic system, shown exposed in FIG. 1;

FIG. 4 is an enlarged vertical sectional view taken along line 4—4 of FIG. 1.

The tractor, as seen in FIGS. 1 and 2 includes a body portion 10, having a front wheel 12, a prime mover or engine 14, and a radiator 16. It also has traction wheels 18, a steering wheel 20, and the other usual well-known tractor parts which have been omitted to avoid complication of the drawing, and which parts it is not necessary to show and describe. A frame 22 is disposed about the tractor and has upstanding columns or arms as 24, to which are pivoted on a pin 26, bucket or loader arms 28 and 30, it being understood that frame member 22 and column 24 are duplicated on the other side of the tractor; a bucket 32 having a re-enforced front shearing edge 34, being carried on pivot 36 on loader arm 28; it being again understood that pivot 36 is duplicated on the other side of the tractor on arm 30.

Loader arms 28 and 30 are raised and lowered by hydraulic cylinders or motors as 38, only one of which is shown, which are pivoted on pins as 40 to columns 24, and on pins as 42 to loader arms 28 and 30, so that extension of motors 38 will cause counterclockwise swinging of arms 28 and 30 about pivot pins 26. This will raise or lower bucket 32.

A tilt cylinder or motor 44 acts to control the position of bucket 32 on pivot 36 and in the present instance, is carried by means of a trunnion 46 on a swinging lever 48 pivoted on a pin 50 on loader arm 28. A link 52 is pivoted on a pin 54 on lever 48 and pivotally connected to bucket 32 on a pin 56. It will be understood that cylinder 44, and its attached parts, is duplicated on loader arm 30 so that a strong symmetrical arrangement is provided for controlling bucket 32. Cylinder 44 has a piston rod 58 anchored to loader arm 28 on a pivot 60 carried on a suitable bracket 62 fixed on loader arm 28.

It will now be apparent that actuation of cylinder 44 in a generally upward direction will throw lever 48 in a counterclockwise direction, and through link 52 will tilt bucket 32 in a counterclockwise direction to loosen a section 64 of the pile of material 66; and while this may take a very substantial force, for example if the material is frozen, the movement is very slight, approximately to the dotted position indicated on the drawing. However, in view of the aforesaid substantial resistance, the fluid pressure necessary to actuate cylinder 44 will be very high, or in the neighborhood of the maximum

pressure which the pumping system, to be described, can deliver.

The fluid is supplied in part by a pump 68 which draws fluid from a sump or tank 70, and delivers it through a discharge pipe or conduit 72. Pipe 72 is connected to a pipe 74 through which fluid may be moved to a control valve 76, A pipe 78 is connected between a pump 80 and pipes 72 and 74. A relief valve 82 is connected with pipe 74 through which fluid may be discharged when delivered in excess of the requirements of cylinders 38 and 44, valve 82 discharging through a suitable conduit 84 back into sump 70. Thus, whenever pump 68 is running, full pressure is available in pipe 74, provided only that pump 68 is operating fast enough to be above the normal operating speed of such pumps. It is well known that pumps of various types have a certain amount of unavoidable leakage or "slip," and a minimum speed is necessary to maintain normal pressure, while supplying the normal amount of fluid which leaks back through the pump. Thus, a certain minimum speed is necessary to maintain the pressure in conduit 74, and the device of the invention is constituted to maintain this minimum speed at all times that engine 14 is running at its normal rate. To avoid loss of fluid through the normal "slip" in pump 80, a suitable check valve 85 may be inserted if desired in pipe 78 between pump 80 and the junction of pipe 72 with pipe 74.

Conduit 74 leads to control valve 76, having an actuating handle 86 which directs fluid to and from cylinder 38 through conduits 88 and 90. Valve 76 also has a handle 92 which directs fluid to and from the cylinder 44 by means of conduits 94 and 96. It will now be apparent that assuming pump 68 to be running, loader arms 28 and 30 and bucket 32 may be swung up and down around pivot 26 by manipulation of handle 86. In similar manner, bucket 32 may be tilted about pivot 36 by manipulation of handle 92.

Commonly, although not necessarily, valve 76 would be of the type which provides an open by-pass for fluid at such times as no work is being performed, the fluid delivered by pumps 68 and 80 being returned to sump 70 through a conduit 98. It will be understood that the tractor is propelled and the motion controlled in any suitable or well-known manner, and the desired work may be accomplished by driving the tractor where desired, and manipulating the bucket 32.

Engine 14 has an output shaft or element 100 which drives through any suitable type of ratio varying transmission 102, in the present instance illustrated as a turbine type coupling, or torque convertor, an output shaft 104. The torque convertor is of a particular advantage in the type of operation described, since when bucket 32 is embedded in pile 66, and the forward motion is blocked, engine shaft 100 may continue to run substantially at governed speed, while output shaft 104 is stopped or nearly so. Rotation of shaft 100 is permitted by "slip" in the coupling or convertor 102 so that engine 14 may develop its full power even with shaft 104 stalled. The full torque of shaft 100, or such torque multiplied by the ratio in convertor 102, is applied to shaft 104 during such operation to maintain the forward thrust of the tractor against bucket 32.

Traction wheels 18 are fixed to axles 106 driven through the usual bull gear mechanism 108 which, in turn, is driven from engine 14 through a transmission 110 of well-known type. Shaft 104 extends rearwardly into transmission 110, which has a driving gear 112 meshing with a driven gear 114, the latter forming a part of bull gear mechanism 108 through which the power is transmitted to traction wheels 18.

However, when traction wheels 18 are stalled, high pressure but a low volume or limited amount of fluid is needed in cylinder 44 for break-out operation. Such operation is attained by driving pump 68 from shaft 100 by means of a gear 116, fixed thereon and driving through an idler gear 118, journaled on a pin 120, a gear 122, fixed on a shaft 124. Pump 68 is therefore driven at a speed in proportion to governed engine speed. Pump 68 is provided with a suitable support 126. Pump 80 is driven from the torque convertor output shaft 104 by means of a gear 128, fixed thereon and driving a gear 130, fixed on a shaft 132. Pump 80 is therefore driven at a rate proportional to the speed of shaft 104. Pump 80 has a support 134. Pump 80 is of sufficient size and capacity for normal work requirements while pump 68 is of smaller size and capacity and is designed to provide the necessary flow of fluid at those times when the traction wheels are stalled or nearly so.

The operation of the device should be generally apparent from the foregoing, but will now be described in detail. Shaft 100 normally runs at governed engine speed, and the operation may be more readily understood if we start with the situation where bucket 32 is stalled in a pile of material before the aforementioned break-out operation. Under these conditions, and as noted in FIG. 3, shaft 100, as stated, will be running at governed engine speed, while shaft 104, being driven from torque convertor 102 and connected with traction wheels 18, will be stalled or stationary; gear 116, fixed on shaft 100, will be running and driving idler 118 which, in turn, will drive gear 122 on shaft 124. Shaft 124 will therefore run in the same direction as engine shaft 100.

At this time, the break-out operation is all that would ordinarily be required of the hydraulic system, and pump 68 supplies the limited volume of fluid for this operation. In this way, pump 68 is kept in operation and absorbs only a limited amount of the power from engine 14, leaving a large proportion thereof in shaft 104 to be transmitted to the traction wheels 18.

Once the break-out operation has been accomplished, the tractor is normally backed away from the pile commonly by virtue of transmission 110, and driven the necessary distance to discharge the contents of the bucket 32. Meantime, it is usually necessary to raise bucket 32 substantially, often to its maximum height which requires activating cylinders 38, which demand a large volume of pressure fluid. Driving the tractor entails the rotation of shaft 104, after a gradual start, at a rate comparable to that of shaft 100, the difference being attributable to normal "slip" in torque convertor 102. Shaft 104 rotates in the same direction as shaft 100, even though slightly slower. Rotation of gear 128 on shaft 104 and meshing with gear 130 causes shaft 132 to run in a direction opposite that of shaft 104.

Variations on the details of the device will doubtless occur to those skilled in the art, and it is to be understood that all of these variations are considered to be within the scope of this application. The invention is not intended to be taken as limited by the embodiment described and illustrated, nor in fact in any manner except as defined in the annexed claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A hydraulically operated tractor loader having a bucket, an engine and a torque convertor driven from said engine, said convertor having an output element, traction means connected in driven relation to said output element, means for supplying hydraulic fluid under pressure, while avoiding excessive power consumption, comprising a

first fluid pump driven from said engine and a

second fluid pump driven from said torque convertor output element, a fluid motor, conduit means connected with both of said fluid pumps and with said fluid motor to insure actuation of the latter from said first pump even though said second pump is stalled, and means connected with said fluid motor and with said bucket and constituted to tilt said bucket by reason of actuation of said fluid motor.

2. A hydraulically operated tractor loader having a

bucket for moving material, support means connected to the tractor and to the bucket, a hydraulic motor connected to the tractor and to the support means for raising and lowering the bucket, a hydraulic motor connected to the support means and to the bucket for tilting the bucket, valve means on the tractor for regulating the flow of hydraulic fluid to said motors, an engine, a torque convertor, an output element for the convertor, means for driving said torque convertor from said engine, a transmission, means for driving said transmission from said torque convertor, traction means, and means for driving said traction means from said transmission, means for providing a fluid supply, while avoiding excessive power consumption, comprising a first fluid pump, means for driving said first fluid pump including a

first drive gear connected with said engine, a

first driven gear engaged with said first drive gear and connected to said first fluid pump, a second fluid pump, conduit means connected to said first and second fluid pumps and to said valve means, and conduit means connected to said valve means and to said hydraulic motors, means for driving said second fluid pump including a

second drive gear connected with said output element, and a

second driven gear, engaged with said second drive gear and connected to said second fluid pump.

3. A tractor loader including a bucket, loader arms connected to the tractor and to the bucket, bucket cylinders connected to the loader arms and to the bucket for tilting the bucket, lift cylinders connected to the tractor and to the loader arms for raising and lowering the bucket, a control valve on the tractor connected for operating the bucket and lift cylinders and conduit means connecting the cylinders and the control valve, an engine, and a torque convertor, means for providing a pressure fluid supply comprising a

sump for said fluid supply, a

first fluid pump connected for moving said fluid,

driving means connected to said engine and to said first fluid pump, a

second fluid pump connected for moving said fluid,

driving means connected to said torque convertor and to said second fluid pump, and

conduit means connected to said sump, and to said pumps,

conduit means connected to said valve and to said pumps, and

conduit means connected to said valve and to said sump.

4. A tractor loader including a bucket, loader arms connected to the tractor and to the bucket, bucket cylinders connected to the loader arms and to the bucket for tilting the bucket, lift cylinders connected to the tractor and to the loader arms for raising and lowering the bucket, a valve on the tractor connected for controlling the operation of the cylinders and conduit means connecting the cylinders and the valve, an engine having an output element, a torque convertor having a power input element and a power output element, a transmission connected with said torque convertor output element, means for providing a pressure fluid supply for said cylinders, comprising a

sump for containing fluid, a

first fluid pump connected for receiving fluid from said sump and for moving said fluid,

driving means connected to said engine output element and to said first fluid pump for driving the same by reason of operation of said engine, a

second fluid pump connected for receiving fluid from said sump and for moving said fluid,

driving means connected to said torque convertor output element and to said second fluid pump for actuating the same by reason of operation of said torque convertor,

conduit means connected to said sump and to said first and second fluid pumps for supplying fluid to said pumps,

conduit means connected to said first and second fluid pumps and to said valve for conducting the combined output of said first and second pumps to said valve, and

conduit means connected to said valve and leading to said sump for conducting spent fluid to said sump.

5. A tractor loader including a bucket, support means connected to the tractor and to the bucket, bucket cylinders connected to the support means and to the bucket for tilting the bucket, lift cylinders connected to the tractor and to the support means for raising and lowering the bucket, a valve on the tractor connected for controlling the operation of the cylinders and conduit means connecting the cylinders and the valve, an engine having an output element, a torque convertor having a power input element and a power output element, a transmission connected with said torque convertor output element, means for providing a pressure fluid supply for said cylinders, while avoiding excessive power consumption, comprising a

sump for containing fluid, a

first fluid pump connected for receiving fluid from said sump and for moving said fluid,

driving means connected to said engine output element and to said first fluid pump for driving the same by reason of operation of said engine, a

second fluid pump connected for receiving fluid from said sump and for moving said fluid,

driving means connected to said torque convertor output element and to said second fluid pump for actuating the same by reason of operation of said torque convertor,

conduit means connected to said sump and to said first and second fluid pumps for supplying fluid to said pumps,

conduit means connected to said first and second fluid pumps and to said valve for conducting the combined output of said first and second pumps to said valve, and

conduit means connected to said valve and leading to said sump for conducting spent fluid to said sump.

6. A tractor loader including a bucket, loader arms connected to the tractor and to the bucket, bucket cylinders connected to the loader arms and to the bucket for tilting the bucket, lift cylinders connected to the tractor and to the loader arms for raising and lowering the bucket, a valve on the tractor connected for controlling the operation of the cylinders and conduit means connecting the cylinders and the valve, an engine having an output element, a torque convertor having a power input element and a power output element, a transmission connected with said torque convertor output element, traction means connected with said transmission, means for providing a pressure fluid supply for said cylinders, while avoiding excessive power consumption, comprising a

sump for containing fluid, a

first fluid pump connected for receiving fluid from said sump and for moving said fluid,

driving means connected to said engine output element and to said first fluid pump for driving the same by reason of operation of said engine, a

second fluid pump connected for receiving fluid from said sump and for moving said fluid,

driving means connected to said torque convertor output element and to said second fluid pump for actuating the same by reason of operation of said torque convertor,

conduit means connected to said sump and to said first and second fluid pumps for supplying fluid to said pumps,

conduit means connected to said first and second fluid pumps and to said valve for conducting the com-

bined output of said first and second pumps to said valve, and

conduit means connected to said valve and leading to said sump for conducting spent fluid to said sump.

7. A tractor loader comprising the combination of an engine having a first output element, a

ratio changing mechanism having a second output element,

means connecting said engine output in driving relation with said ratio changing mechanism,

traction means, and means connected in driving relation with said second output element and with said traction means, a

first pump having a first discharge conduit,

means connected in driving relation with said first output element and with said first pump, a

second pump having a second discharge conduit,

means connected in driving relation with said second output element and with said second pump,

conduit means connecting said first discharge conduit in communication with said second discharge conduit, a

fluid motor, a

loader bucket,

means connecting the fluid motor with the loader bucket in relation to tilt said bucket in response to actuation of said fluid motor, and

conduit means connecting both of said discharge conduits to said fluid motor whereby said fluid motor may tilt said bucket by virtue of fluid delivered by said first pump at times when said engine is running and said second output element and said second pump are in stalled condition.

8. A tractor loader as claimed in claim 7 including a second fluid motor,

means connecting said second fluid motor with said bucket in relation to raise and lower said bucket in response to actuation of said second fluid motor, and

conduit means connecting both of said discharge conduits to said fluid motors.

9. A tractor loader as claimed in claim 8 including a control valve,

means communicating with both of said discharge conduits and with said control valve,

conduit means connected with said control valve and with said first motor, and

conduit means connected with said control valve and with said second motor, whereby fluid is available in small volume but at high pressure to operate one of said fluid motors when said engine is running but said traction means is stalled, and in large volume and at high pressure to operate both of said fluid motors when said engine and said traction means are running.

10. A tractor loader as claimed in claim 7 in which said ratio changing mechanism comprises a fluid coupling.

11. A tractor loader as claimed in claim 7 in which said ratio changing mechanism comprises a hydraulic torque convertor.

12. A tractor loader as claimed in claim 8 in which said ratio changing mechanism comprises a fluid coupling.

13. A tractor loader as claimed in claim 8 in which said ratio changing mechanism comprises a hydraulic torque convertor.

14. A tractor loader as claimed in claim 9 in which said ratio changing mechanism comprises a fluid coupling.

15. A tractor loader as claimed in claim 9 in which said ratio changing mechanism comprises a hydraulic torque convertor.

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