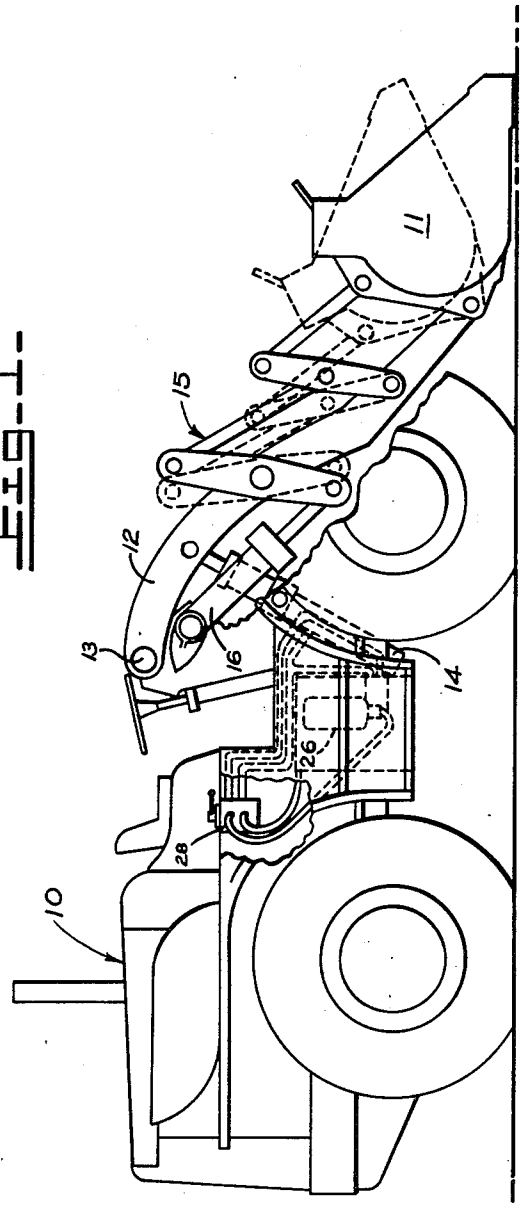
Feb. 25, 1964 A. L. FREEDY ET AL 3,122,246

HYDRAULIC CIRCUIT FOR TRACTOR MOUNTED LOADERS

Filed Nov. 9, 1960 2 Sheets-Sheet 1

Fig. 1



INVENTORS
ALLAN L. FREEDY
ROBERT G. McINDOO
BY
Fryer and Tjensvold
ATTORNEYS

Feb. 25, 1964 A. L. FREEDY ET AL 3,122,246

HYDRAULIC CIRCUIT FOR TRACTOR MOUNTED LOADERS

Filed Nov. 9, 1960 2 Sheets-Sheet 2

Fig. 2.

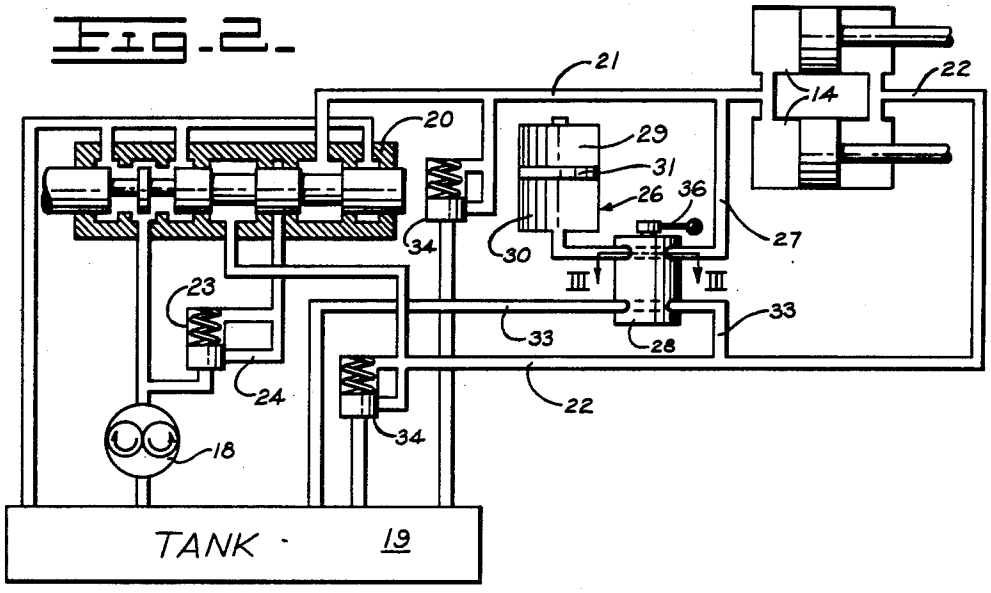


Fig. 3.

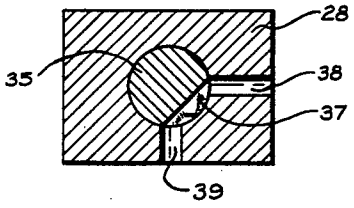


Fig. 4.

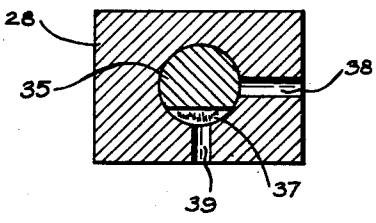
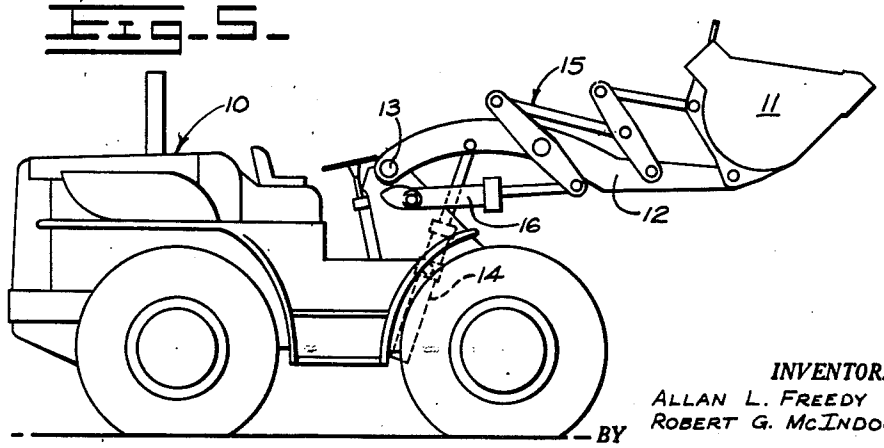


Fig. 5.



INVENTORS
ALLAN L. FREEDY
ROBERT G. McINDOO

BY Fryer and Tjensvold

ATTORNEYS

United States Patent Office 3,122,246 Patented Feb. 25, 1964

3,122,246
HYDRAULIC CIRCUIT FOR TRACTOR MOUNTED LOADERS

Allan L. Freedy and Robert G. McIndoo, Aurora, Ill., assignors to Caterpillar Tractor Co., Peoria, Ill., a corporation of California

Filed Nov. 9, 1960, Ser. No. 68,254
4 Claims. (Cl. 214—140)

This invention relates to tractor mounted loaders and particularly to a circuit having means to improve the riding qualities of a loader and to provide smoother and more efficient loading of the bucket.

This application is a continuation in part of our copending application for "Hydraulic Circuit for Tractor Mounted Loaders" filed April 18, 1960, Serial No. 22,934, now abandoned.

In bucket loaders mounted on wheel-type tractors, the bucket is usually carried in a raised position forwardly of the loader either in transporting the load or in moving the machine from one location to another with an empty bucket. The weight even of an empty bucket and its associated linkage in this position tends to counterbalance the machine to the extent that movement over rough terrain creates a hazardous bouncing or pitching of the machine. This is particularly true at high speeds and, even on a relatively smooth highway with regularly spaced expansion joints or the like, a very slight bouncing action is increased by a harmonic effect at certain speeds to the extent that control of the machine is difficult and dangerous.

Another difficulty encountered in the operation of loaders occurs in the loading or bucket filling cycle. It is common practice in filling a bucket to advance it in lowered position into the material to be loaded and as the bucket is nearly filled to rack it or tilt it rearwardly in order to obtain a large load and to retain the load in a carry position as the bucket is lifted and then transported. In the so-called "rack back" position the bottom of the bucket slopes upwardly and since there is some final forward movement in the load cycle it rides upwardly on the earth or other material. This upward movement is transmitted through the lift arms to the tractor reducing the weight on the front wheels and thereby the traction, often to the extent that the wheels spin, and sometimes to the extent that they are raised from the ground. Consequently deep ruts are cut in the ground at the loading site necessitating frequent repair and loss of useful work time. Excessive tire wear also results from the operation described.

It is the object of the present invention to provide means in combination with the hydraulic circuit which controls the bucket position of a loader to cushion or damp the movement of a raised bucket and thereby improve the riding qualities of the machine and also to cushion the action of the bucket during the load cycle to reduce the tendency described above to raise the front wheel of the vehicle from the ground.

It is a further object of the invention to provide means to disassociate the damping means from the circuit when desired.

Still further objects and advantages of the invention and the manner in which they are carried into practice are made apparent in the following specification wherein the invention is described in detail by reference to the accompanying drawings.

In the drawings:

FIG. 1 is a view in side elevation of a typical tractor mounted loader of the type to which the present invention pertains illustrating the location of the principal elements of the present invention thereon;

FIG. 2 is a schematic view of a hydraulic circuit for actuating the bucket lift mechanism of a loader including the damping means and control therefor of the present invention;

FIG. 3 is a sectional view taken on the line III—III of FIG. 1 through a control valve which forms a part of the present invention;

FIG. 4 is a sectional view like FIG. 3 showing the valve parts in a different position; and

FIG. 5 is a view like FIG. 1 on a reduced scale showing the loader bucket in a different position.

The invention is illustrated in FIG. 1 of the drawings as applied to a wheel-type tractor generally indicated at **10** which supports a bucket **11** for the usual digging, lifting and carrying operations at the end of a pair of lift arms **12**. The lift arms are pivoted to the tractor as at **13** and a pair of lift jacks, one of which is illustrated at **14** in FIG. 1 are actuated by hydraulic fluid for raising and lowering the lift arms and the bucket. The angle of the bucket with respect to the lift arms is regulated through tilt linkage generally indicated at **15** and controlled by hydraulic jacks one of which is shown at **16**. The construction and operation of this tilt mechanism is well known and need not be described in further detail as it forms no part of the present invention.

The hydraulic circuit for the lift jacks **14** is schematically illustrated in FIG. 2 of the drawings. In FIG. 2, a pump indicated at **18** directs fluid under pressure from a tank **19** through a control valve **20** selectively to the head ends or rod ends of the jacks **14** through lines **21** and **22** respectively. The control valve **20** is of the spool type and operates in a conventional manner upon sliding movement of the spool in opposite directions to direct fluid under pressure to the opposite ends of the jacks. A check valve **23** is disposed in a line **24** to prohibit reverse flow of oil from the jacks which prevents dropping the load in the event of pump failure or engine shutdown.

It is when the bucket is carried above the ground as in the position illustrated in FIG. 5 of the drawings that bouncing action is transmitted to and tends to overbalance the tractor through the jacks **14** and through the column of incompressible hydraulic fluid in the line **21** (FIG. 2). To cushion this action, an accumulator **26** is connected with the line **21** and the head ends of the jacks **14** by a line **27** and a valve **28** which is disposed adjacent the operator's station of the tractor as shown in FIG. 1. The accumulator which may be any one of several available types includes a gas chamber **29** and a hydraulic fluid chamber **30** separated by a floating piston **31**. The elasticity or compressibility of the gas in the chamber **29** permits limited movement of the piston and cushions the shock which is transmitted to the tractor by the bouncing action of the bucket and its associated linkage. Accumulators placed in hydraulic circuits much in the same manner thus far disclosed have previously been employed for cushioning the action of a loader bucket when it is being used for digging or loading to cushion the shock transmitted to the hydraulic system and prevent bursting of hydraulic lines and fittings when peak loads are abruptly encountered. They are, however, inadequate for the purpose of the present invention because, even though they cushion the shock of the motion of the jack piston in one direction, that motion tends to evacuate the line communicating with the opposite ends of the jacks such for example as the line **22** shown in FIG. 2 and, upon return movement, the pistons encounter the solid incompressible column of hydraulic fluid in the line **22** thus producing an undesirable shock effect. The present invention eliminates this reverse movement or rebound shock effect by the provision of a line **33** which forms a by-pass from the line **22** to the tank **19** and is controlled, together with

the line 27, by the valve 28. Thus when the valve 28 is manipulated to open the lines 27 and 33, the action of the pistons 14 is cushioned in both directions of their movement because as they move toward the head ends of the jacks, they compress the gas in the chamber 29 and withdraw fluid from the tank 19 into the rod ends of the jacks. In this way the accumulator changes the natural frequency of the machine by changing the spring rate of the system supporting the bucket and its associated linkage. Thus upon return or rebound movement of the pistons, they expel fluid through the line 22 and by-pass 33 to the tank and are not abruptly stopped as they would be were it not for the by-pass. The friction of the fluid passing through the lines also augments the cushioning effect by damping the spring effect at a faster rate than that of a system with the accumulator only. When the control valve 20 is in the neutral position the supply to both ends of the cylinders from the tank 19 is blocked and check valves shown at 34 and known as make-up valves are employed in a well known manner to admit make-up fluid from the supply tank 19 to the cylinders when required.

The function of the valve 28 is to cut the accumulator and by-pass line 33 out of the circuit if it is desired to operate the loader without them. As shown in FIGS. 3 and 4 the body of the valve 28 has a central cylindrical bore for reception of a rotatable plug 35 actuated by a hand lever 36 shown in FIG. 2. The valve plug has two cut-away portions one of which is shown at 37 in FIGS. 3 and 4 to open or close communication between inlet and outlet passages 38 and 39 to control flow in the line 27. Duplicate configuration controls flow simultaneously through the line 33. The valve 28 may be placed adjacent the operator's station as shown in FIG. 1 where a suitable location for the accumulator 26 is also indicated.

The manner in which the circuit of FIG. 2 improves the bucket loading operation may best be understood by reference to FIG. 1 wherein the bucket is shown in full lines in loading position or in the first part of the forward movement which causes the bucket to enter the material to be loaded. As the bucket is nearly full, the operator actuates it or racks it back to the dotted line position gathering the final portion of the load and holding it in the position to be raised and transported. Since the machine is moving forwardly at the time of the rack-back the bottom of the bucket, now inclined forwardly and upwardly, rides upwardly on the material beneath it and, through the lift arm 12, normally rigid under these conditions, tends to lift the forward end of the tractor from the ground. Since all four wheels are driven wheels during loading the front wheels are free to spin cutting ruts in the ground, the proportions of which soon interfere with subsequent loading cycles and the spinning of the wheels also causes rapid tire wear. This lifting of the front end of the tractor imposes stress on the pistons in the cylinders 14 exerting tension on their rods which by reference to FIG. 2 is seen to be relieved by the flow of fluid from the rod ends of the cylinders through the by-pass 33 to the tank 19. Thus the pistons are free for cushioned movement as permitted by the accumulator 26 and by-pass line 33 so that slight upward movement of the bucket at the end of the loading cycle does not raise the forward end of the tractor and permit spinning of the front wheels. Should piston 31 of the accumulator reach the end of its stroke, additional fluid is admitted to the jacks 14 from the tank 19 by way of make-up valve 34 in line 21.

We claim:

1. In a tractor mounted loader which includes a bucket carried on arms pivoted to a tractor, hydraulic jacks for effecting raising and lowering of said arms, and a hydraulic circuit including a control valve for directing fluid under pressure from a supply tank selectively to opposite ends of said jacks while permitting return of fluid from the other ends, said valve having a closed position preventing such return of fluid, means to cushion bouncing action of said bucket when it is elevated comprising an accumulator in said circuit in communication with the ends of said jacks which are under pressure when the bucket is elevated, a by-pass forming communication between the opposite ends of said jacks and said supply tank when said valve is in its closed position, control means in said circuit controlling communication between the accumulator and the ends of the jacks, and control means in said circuit controlling the by-pass.

2. In a tractor mounted loader which includes a bucket carried on arms pivoted to a tractor, hydraulic jacks for effecting raising and lowering of said arms, and a hydraulic circuit including a control valve for directing fluid under pressure from a supply tank selectively to opposite ends of said jacks while permitting return of fluid from the other ends, said valve having a closed position preventing such return of fluid, means to cushion bouncing action of said bucket when it is elevated comprising an accumulator in said circuit in communication with the ends of said jacks which are under pressure when the bucket is elevated, a by-pass forming communication between the opposite ends of said jacks and said supply tank when said valve is in its closed position, and valve means in said circuit to interrupt communication between the accumulator and the jacks and to control the by-pass.

3. In a tractor mounted loader which includes a bucket carried on arms pivoted to a tractor, hydraulic jacks for effecting raising and lowering of said arms, and a hydraulic circuit including a control valve for directing fluid under pressure from a supply tank selectively to opposite ends of said jacks while permitting return of fluid from the other ends, said valve having a closed position preventing such return of fluid, means to cushion bouncing action of said bucket when it is elevated comprising an accumulator in said circuit in communication with the ends of said jacks which are under pressure when the bucket is elevated, a by-pass forming communication between the opposite ends of said jacks and said supply tank when said valve is in its closed position, valve means in said circuit to control communication between the accumulator and the jacks, and valve means in said circuit to close said by-pass.

4. In a tractor mounted loader which includes a bucket carried on arms pivoted to a tractor, hydraulic jacks for effecting raising and lowering of said arms and tilting of said bucket, and a hydraulic circuit including a control valve for directing fluid under pressure from a supply tank selectively to opposite ends of said jacks for raising and lowering the arms while permitting return of fluid from the other ends, said valve having a closed position preventing such return of fluid, means to cushion upward movement of the arms caused by advancing the bucket into material while it is tilted rearwardly comprising an accumulator in said circuit in communication with the ends of said jacks which are under pressure when the bucket is elevated, a by-pass forming communication between the opposite ends of said jacks and said supply tank when said valve is in its closed position whereby force tending to raise the forward end of the tractor from the ground is reduced, and a valve in said circuit controlling the communication between the accumulator and the jacks and controlling the by-pass.

References Cited in the file of this patent

UNITED STATES PATENTS

2,672,995	Drott	Mar. 23, 1954
2,708,344	Greer	May 17, 1955
2,860,793	Lapsley	Nov. 18, 1958

FOREIGN PATENTS

468,478	Great Britain	July 6, 1937