United States Patent

Peterson

[15] **3,658,202**

[45] **Apr. 25, 1972**

[54] LOADER WITH IMPROVED STABILITY AND INCREASED REACH

[72] Inventor: **Robert A. Peterson**, San Leandro, Calif.

[73] Assignee: **Caterpillar Tractor Co.**, Peoria, Ill.

[22] Filed: **June 1, 1970**

[21] Appl. No.: **42,001**

[52] **U.S. Cl.** **214/770**

[51] **Int. Cl.** **E02f 3/62**

[58] **Field of Search** 214/773, 779, 140, 769, 770, 214/777, 778

[56] **References Cited**

UNITED STATES PATENTS

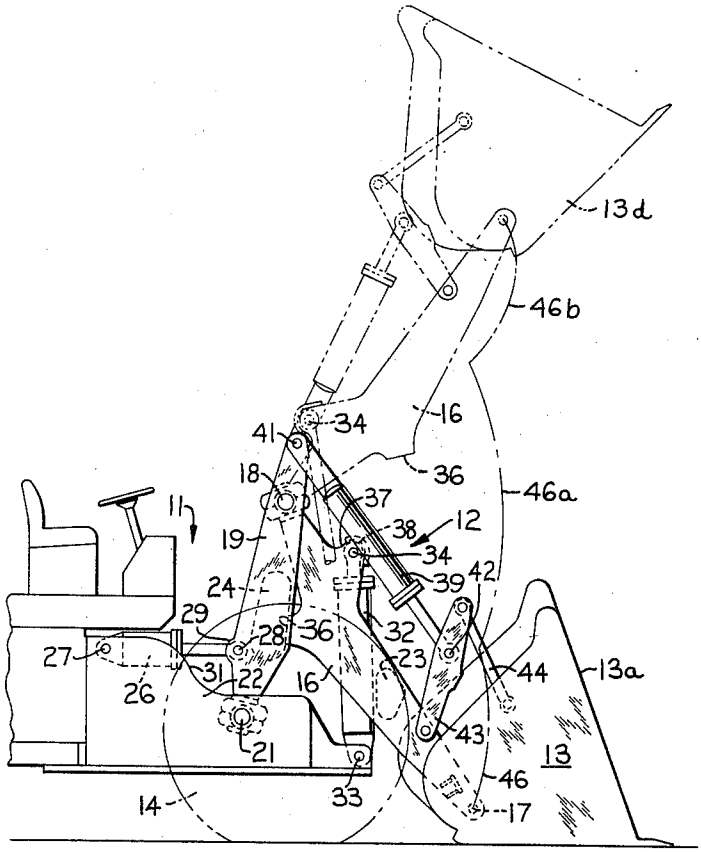
3,519,156	7/1970	Magnuson	214/770 X
2,820,555	1/1958	Lessmann	214/770
2,980,271	4/1961	Ulinski	214/770
3,353,699	11/1967	Svoboda	214/776
3,024,933	3/1962	Albert et al.	214/770
2,707,059	4/1955	Gerst	214/770

Primary Examiner—Gerald M. Forlenza
Assistant Examiner—John Mannix
Attorney—Fryer, Tjensvold, Feix, Phillips & Lempio

[57] **ABSTRACT**

End loader linkage for effecting lift travel of a bucket in a plurality of relatively small arcs approximating a nearly vertical line closely adjacent the end of the loader to increase the loader's lifting and digging capacity in the digging and carry positions, improve bucket lift travel through a bank while filling the bucket, and increase the lift height and reach of the bucket for dumping.

4 Claims, 3 Drawing Figures



Patented April 25, 1972 3,658,202

2 Sheets-Sheet 1

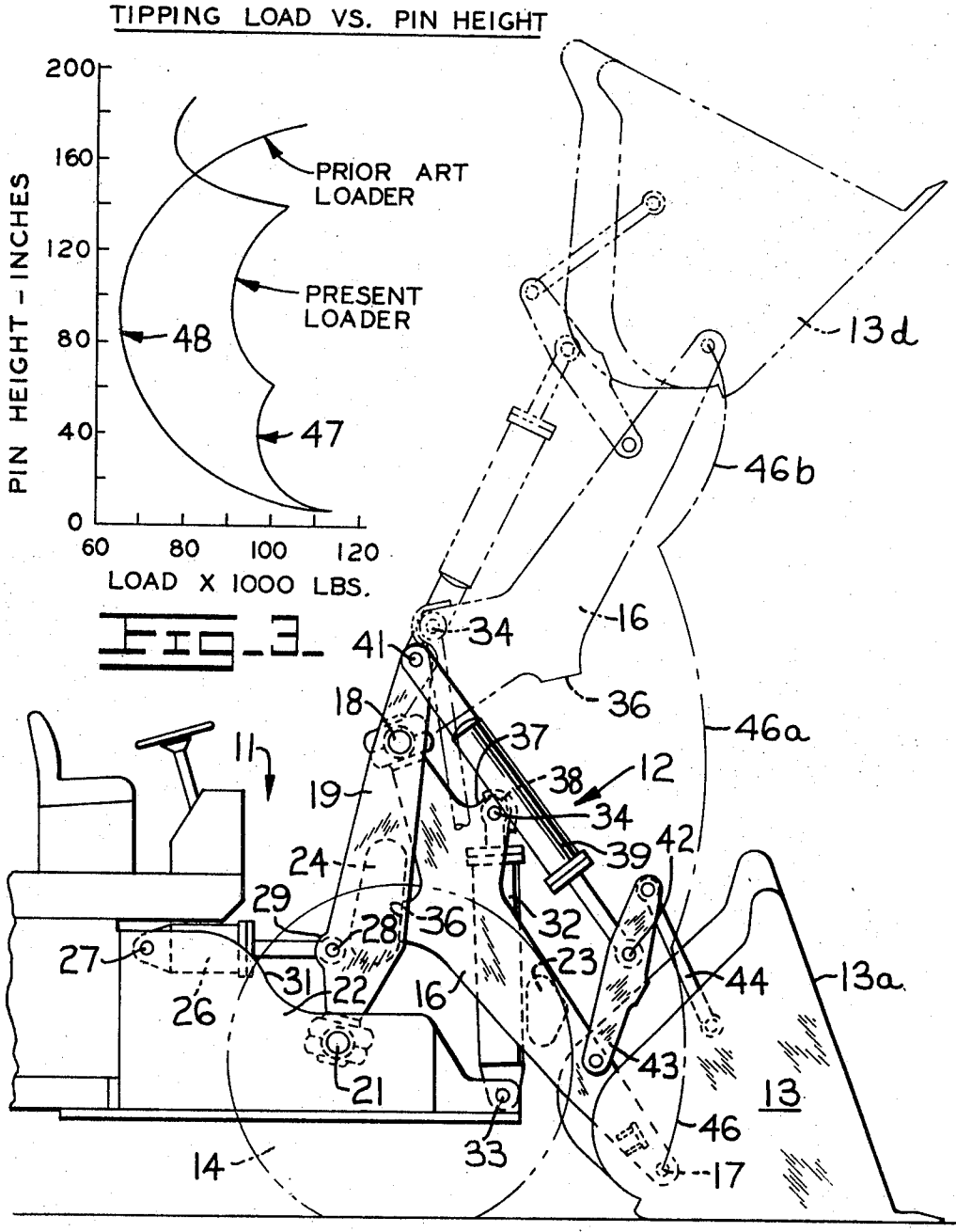


Fig. 3

Fig. 1

INVENTOR
ROBERT A. PETERSON

BY
Fryer, Tyrrell, Feix, Phillips & Lempio
ATTORNEYS

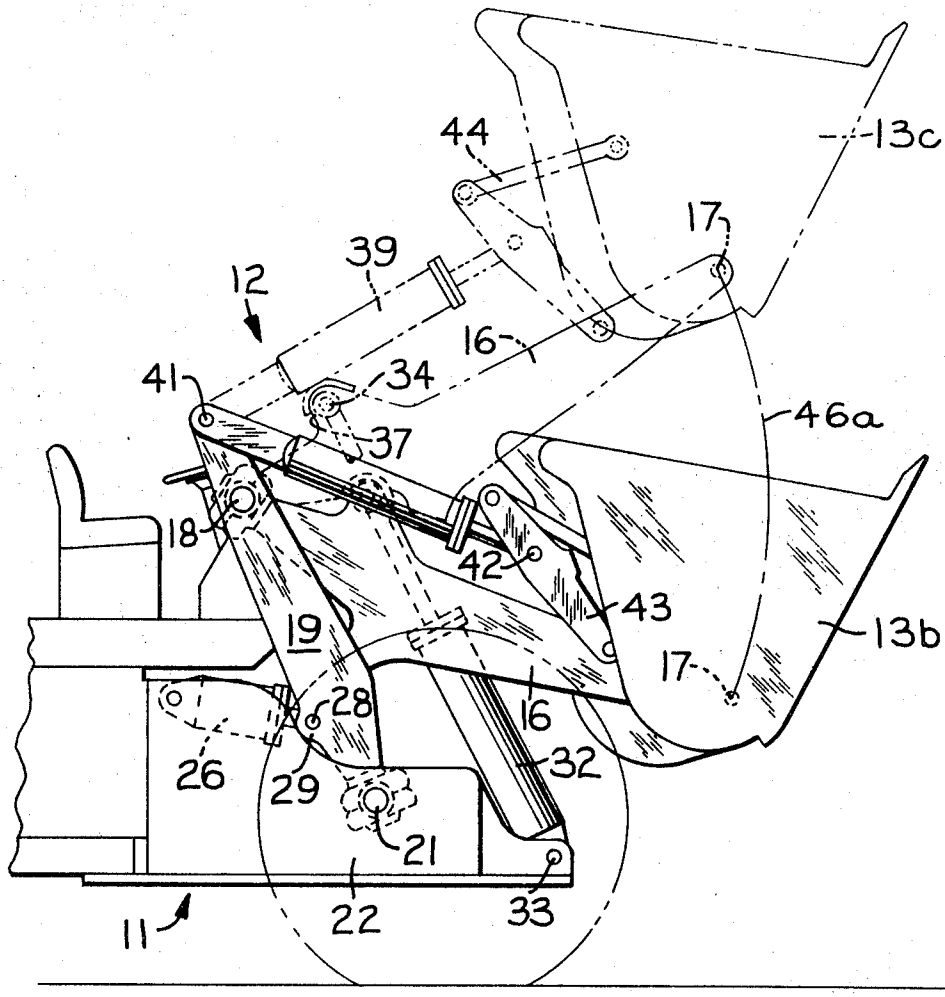


FIG-2-

INVENTOR
ROBERT A. PETERSON

BY
Fraser, Trimmel, Fein, Phillips & Lempio
ATTORNEYS

LOADER WITH IMPROVED STABILITY AND INCREASED REACH

BACKGROUND OF THE INVENTION

Conventional wheel loaders generally have the lift arms attached to the loader frame by fixed pivots such that during raising of the arms to elevate the bucket, the forward ends of the arms swing in an arc about the pivots. The bucket is consequently moved forwardly of the front wheels of the vehicle as the bucket is elevated from ground level through the digging cycle. This poses a problem in that the tipping force caused by the loaded bucket tending to tip the vehicle about its front wheels increases during the digging cycle by virtue of the increasing forward displacement of the load therefrom.

The point at which the greatest tipping force occurs, i.e., point of maximum forward displacement of the bucket from the front wheels, generally coincides with the normal carry position of the bucket. This is a principal factor which dictates the bucket size for a given vehicle. To increase the bucket capacity, counterweights must be added to the rear of the vehicle, thereby adding more dead weight to be carried by the vehicle. Likewise, counterweights must be added if it is attempted to increase the lift height of the bucket by lengthening the lift arms, the forward displacement of the bucket from the front wheels during digging being correspondingly increased.

A further problem encountered with the conventional arrangement is that the hydraulic lifting capacity is greatest at ground level and rapidly decreases as the bucket is elevated.

Various linkages have been devised with a view towards eliminating one or more of the problems attending the conventional arrangement wherein the lift arms are connected to the loader frame by means of fixed pivots. In this regard, the lift arms have been pivotally connected to pivoted levers, and means provided for coordinated movement of the arms and levers to change the bucket lift travel from the single arc of the more conventional arrangement to a plurality of smaller arcs such that the bucket travels upwardly in a more nearly vertical line.

However, these prior linkages have suffered from various disadvantages. For example, with some of these linkages there is no provision for bucket correction or means to tilt the bucket during loading. In other instances, the linkage is such that the bucket moves too far forward during the critical dig and carry portions of the lifting range, thereby decreasing the stability of the vehicle during the carry cycle. The reach at the upper dump height has also been relatively limited.

SUMMARY OF THE INVENTION

The present invention relates to an end loader linkage for effecting bucket lift travel in a plurality of arcs approximating a vehicle line closely adjacent the front wheels of the vehicle, which linkage includes hydraulic jacks positioned to provide a more favorable mechanical advantage for lifting capacities, particularly in the digging ranges, and results in a lift wherein the center of gravity of the bucket is maintained in a more favorable position with respect to the forward end of the vehicle to increase its ability to counterbalance heavier loads while maintaining a more favorable dumping height and reach position.

The linkage of the present invention basically includes lift arms having a bucket pivotally connected to one end and pivotally connected at the other end to lever arms in turn pivotally connected to and upwardly projecting from the front frame of a vehicle.

Hydraulic jack means are coupled between the frame and lever arms for selectively pivoting same between first and second positions respectively angularly displaced slightly forward and rearward of the vertical. Second hydraulic jack means are coupled between the frame and the lift arms at points forwardly adjacent their pivotal connections to the lever arms and upwardly displaced from a plane intersecting the pivot connections at the opposite ends of the lift arms. The

first and second jack means may be actuated to effect correlated pivotal movements of the lift arms and lever arms commensurate with lift travel of the bucket from the ground level upwardly through three interconnected arcs approximating a vertical line. Hydraulically actuated tilt means are coupled to the bucket to impart tilting movement thereto between load and dump positions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the front portion of a loader embodying the linkage of the present invention, the ground level dig position of the bucket and linkage being illustrated in full line, and the fully elevated position thereof being depicted in dashed-dotted line.

FIG. 2 is a view similar to FIG. 1, but illustrating two intermediate positions of the bucket and linkage respectively in full and broken lines.

FIG. 3 is a graph of the bucket pivot pin height versus tipping load, comparing the present loader linkage to the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2 in detail, there is shown the forward portion of a front end loader 11 having a linkage 12, in accordance with the present invention, for elevating a bucket 13 from a ground level digging position (depicted in full line in FIG. 1) adjacent the front wheels 14 of the vehicle along a nearly vertical path of travel to a fully extended elevated position (depicted in broken line in FIG. 1).

More particularly, unlike various conventional linkages which elevate the bucket along a single long arc, the linkage 12 is arranged to provide a path of bucket lift travel defined by a succession of short arcs which approximate a vertical line. By providing a more nearly vertical path of travel, the forward excursion of the bucket from the front wheels of the vehicle is minimized during lifting, thereby providing improved tip stability.

The linkage 12 is further arranged to provide increased lifting and digging capacity in the carry and digging positions, improved bucket lift travel through the bank while filling the bucket, while at the same time increasing the lift height and reach of the bucket for dumping, compared to existing linkage designs which have attempted to also provide a more nearly vertical path of lift travel.

The linkage 12 includes a pair of parallel transversely spaced lift arms 16 pivotally supporting the bucket 13 at one end, as by means of pins 17, for movement about a transverse axis, and having their opposite ends pivotally connected, as indicated at 18, to a pair of parallel transversely spaced upwardly projecting lever arms 19. The lower ends of the lever arms 19 are pivotally connected at 21 to the front frame 22 of the loader 11 for movement about a transverse axis at a position rearwardly displaced from the rotational axis of the front wheels 14.

The lift arms 16 are preferably interconnected by a cross beam 23, and the lever arms 19 are preferably interconnected by a cross beam 24. In the illustrated case, the pivot connections 18 of the lift arms are displaced from the free ends of the lever arms and the cross beam 24 is intermediate the pivot connections 18 and the lower end pivot connections 21 of the lever arms.

In order to control pivotal movement of the lever arms 19, a pair of hydraulic jacks 26 are pivotally connected, as indicated at 27, to the front frame 22 at points rearwardly displaced from the lever arm pivot connections 21, and have their rod ends pivotally connected to the lever arms as indicated at 28. The jacks are preferably substantially horizontally disposed with the rod pivot connections 28 upwardly displaced a short distance from the lever arm pivot connections 21.

The jacks are effective to selectively actuate the lever arms between a first position slightly angularly displaced forwardly

of the vertical, as shown in FIG. 1, and a second position angularly displaced rearwardly of the vertical, as shown in FIG. 2. The lever arms are preferably formed with raised stops 29 on their rear edges adjacent rod pivot connections 28 for abutting inclined portions 31 of the frame when the lever arms are in their second or rearward positions.

Raising or lowering of the lift arms 16 about their pivot connections, 18 to the lever arms 19 is similarly effected by means of a pair of hydraulic jacks 32 pivotally connected, as indicated at 33, to the front frame 22 at points forwardly displaced from the lever arm pivot connections 21, and having their rod ends pivotally connected to the lift arms as indicated at 34.

It is important to note that the jacks 32 are substantially vertically disposed when the lever arms 19 are at their forward extremes and the lift arms 16 are at their lowermost extremes to position the bucket 13 at ground level for digging, as shown in full line in FIG. 1. To limit pivotal movement of the lift arms in this digging position, the rear edges of the lift arms are preferably formed with outwardly projecting stops 36 at positions spaced forwardly from the pivot connections 18 for abutting the cross arm 24 between the lever arms. By virtue of the substantially vertical position of the lift jacks 32, a more favorable mechanical advantage is gained for lifting capacities, particularly in the digging ranges of the bucket.

The locations of the connections 34 of the rods of jacks 32 to the lift arms are also important to the ends of the present invention. In the illustrated embodiment, the forward edges of the lift arms are formed with raised portions 37 forwardly spaced from the lift arm pivot connections 18, and a formed plate 38 extends transversely between such raised portions. The lift jack rod connections are then journaled to the raised portions. In any event, irrespective of the particular configuration of lift arms employed, the rod connections 34 are upwardly displaced from a plane intersecting the pivot connections 17 and 18 at the opposite ends of the lift arms.

The linkage 12 further includes means for tilting the bucket 13 between load, carry and dump positions about the pivots 17. Although the tilt means may be variously provided, in the illustrated embodiment such means include hydraulic jacks 39 pivotally connected at 41 to the free ends of lever arms 19 and having their rods pivotally connected, as indicated at 42, to intermediate points of levers 43 which, in turn, have one end pivotally connected to the lift arms 16 rearwardly of the bucket. The jacks impart swinging movement to the levers 43 which in turn impart tilting movement to the bucket through links 44 connected between the opposite ends of the levers and the bucket.

Considering now the operation of the linkage 12, assume that the linkage initially positions the bucket 13 in digging position 13*a* as depicted in FIG. 1. At this time, the jacks 26 are extended whereby the lever arms 19 are in their forward positions, and the jacks 32 are retracted whereby the lift arms 16 are in their lowermost positions.

During the initial portion of the lifting cycle, jacks 26 are retracted and jacks 32 are partly extended to cause the linkage and bucket to assume the position indicated at 13*b* in FIG. 2. At this time, the lever arms 19 are in their rearward positions and the jacks 32 are in a partially extended position such that the lift arms 16 are partially raised. In moving from position 13*a* to position 13*b*, the bucket pivot pins 17 traverse an arcuate path as indicated at 46.

Further extension of the jacks 32 effects rotation of the lift arms about the pivot connections 18 until the bucket reaches the position indicated at 13*c*. The lift arms have now assumed positions determined by full extension of the jacks 32. During movement from position 13*b* to position 13*c*, the bucket pivot pins 17 have traversed an arcuate path 46*a*.

The lever arms 19 are then moved to their forward positions by extension of the jacks 26. Even though the lift arms had been previously elevated to the maximum extent possible by full extension of the jacks 32 alone, the lift arms are now further elevated to a position of full lift height, as indicated at 13*d*, by virtue of the geometry of the linkage.

The bucket pivot pins 17 traverse an arcuate path 46*b* during such action of the linkage. More particularly, it is to be noted that by virtue of the relative positions of pivot connections 18 and 34 to the lift arms, forward movement of the lever arms effects upward pivotal movement of the lift arms about connections 34 to thereby elevate the bucket to the full height position 13d.

As illustrated in the drawings, the tilt jacks 39 are retracted to maintain the bucket in its load and carry positions during elevation of the bucket from ground position 13*a* to full height position 13*d* in the manner hereinbefore described. In the full height position, the jacks 39 are extended to thereby dump the bucket. It should be noted, however, that the bucket may be dumped at any point of the lifting cycle, if desired, by actuating the tilt jacks.

With the action of the linkage 12 in elevating the bucket along the path defined by the successive arcs 46, 46*a*, and 46*b*, the bucket lift travel is very nearly vertical and relatively closely adjacent the front wheels 14 of the loader, thereby improving its ability to balance larger loads without counterweighting. In this regard, reference is made to FIG. 3 which depicts the bucket pivot pin height versus tipping load characteristic for a loader with the present linkage 12 compared to a conventional linkage wherein the pivot point of the lift arms is fixed.

The tipping loads plotted are loads on the bucket pivot pins for which the rear wheels of the vehicle leave the ground. The curve 47 represents the present linkage while the curve 48 represents the linkage of a prior art loader. As shown by curve 48, the maximum load that the prior art loader can lift from ground level to full height is limited by a tipping load of approximately 65,500 lbs. when the bucket pivot pins are 90 inches above the ground. Since the normal carry height is with the pin between 60 and 90 inches, the tendency of the load in the bucket to tip the vehicle is greatest when the bucket is in the carry position.

With the present linkage 12, as shown by curve 47, the maximum load is limited by a tipping load of approximately 78,000 lbs. when the bucket pivot pins 17 are at a height of 165 inches above the ground, while the tipping load at 90 inches is 91,000 lbs.

It will be thus appreciated that the present linkage is able to lift a larger load and still have better stability in the carry position than the prior art loader, or if equal loads are carried by both machines, the machine with the present linkage has greatly improved stability.

It is to be noted that the linkage 12 not only improves the stability and increases the lifting capacity of the loader, but in addition it provides improved bucket lift travel through the material being loaded. In conventional loaders the vehicle crowds the unit into the material bank while the lift arms traveling with a constant radius also tend to crowd the bank. Such double movement tends to stall the loader, and it is usually necessary to provide relief by racking back the bucket to decrease the swinging radius thereof, thereby reducing the vehicle push.

The instant linkage 12, on the other hand, while still having the vehicle crowd the bucket into the material bank, provides an improved path with the bucket which is much more vertical than horizontal. In this manner, the bucket lip travels more nearly straight up through the bank, making it easier to dig and cut material to fill the bucket.

In summary, there is provided by the present invention an improved loader linkage which has hydraulic jacks positioned to provide a more favorable mechanical advantage for lifting capacities, particularly in the digging ranges. In addition, the linkage results in a lift wherein the center of gravity of the bucket is maintained in a more favorable position with respect to the forward end of the vehicle to thereby increase its ability to counterbalance heavier loads while maintaining a more favorable height and reach position. These combined features facilitate the application of a larger capacity bucket to a smaller machine without excessive counterweighting which does not contribute to pay load.

Although the invention has been hereinbefore described and illustrated in the accompanying drawings with respect to a preferred embodiment, various modifications and changes may be made therein without departing from the true spirit and scope of the invention, and thus it is not intended to limit the invention except by the terms of the appended claims.

What is claimed is:

1. End loader linkage for effecting lift travel of a bucket on a vehicle having a frame and wheels comprising a pair of transversely spaced parallel lever arms pivotally connected to and upwardly projecting from the front frame of said vehicle at points rearwardly displaced from the rotational axis of the front wheels thereof, a pair of transversely spaced parallel lift arms having first ends pivotally connected to said lever arms and second ends pivotally connected to said bucket, hydraulic jack means coupled between said front frame and said lever arms for selectively pivoting same between first and second positions respectively angularly displaced forwardly and rearwardly of the vertical, a cross beam transversely interconnecting said lever arms at a position intermediate the pivot connections of said lever arms to said frame and the pivot connections of said lift arms to said lever arms, said lever arms having raised stops on the rear edges thereof for abutting said frame when said lever arms are in said second position thereof, said lift arms having outwardly projecting stops on the rear edges thereof at positions spaced forwardly from the pivot connections of said lift arms to said lever arms for abutting said cross beam when said lift arms are in lowered position, second hydraulic jack means coupled between said frame and said lift arms for selectively raising and lowering the latter about their pivot connections to said lever arms, said second hydraulic jack means pivotally connected to said lift arms at points forwardly adjacent their pivotal connections to said lever arms and upwardly displaced from a plane intersecting the pivot connections at the first and second ends of said lift arms, and hydraulically actuated tilt means coupled to said bucket for selectively imparting tilting movement thereto about its pivot connections to said lift arms, whereby said first and second hydraulic jack means are actuated to effect correlated pivotal movement of said lever arms and lift arms commensurate with lift travel of said bucket from ground level upwardly through three interconnected arcs approximating a vertical line and said tilt means are actuated to tilt said bucket between load, carry, and dump positions.

2. End loader linkage for effecting lift travel of a bucket on a vehicle having a frame and wheels comprising a pair of transversely spaced parallel lever arms pivotally connected to and upwardly projecting from the front frame of said vehicle at points rearwardly displaced from the rotational axis of the front wheels thereof, a pair of transversely spaced parallel lift arms having first ends pivotally connected to said lever arms and second ends pivotally connected to said bucket, first hydraulic jack means including a pair of substantially horizontally disposed hydraulic jacks pivotally connected to said front frame at points rearwardly displaced from the pivot connections of said lever arms to said frame and having their rod ends pivotally connected to said lever arms at points upwardly adjacent their pivot connections to said frame for selectively pivoting said lever arms between first and second positions respectively angularly displaced forwardly and rearwardly of the vertical, second hydraulic jack means including a second pair of hydraulic jacks pivotally connected to said frame at points forwardly displaced from the pivot connections of said lever arms thereto and having their rod ends pivotally connected to said lift arms, said second pair of jacks being substantially vertically disposed when said lever arms are in said first positions thereof, and hydraulically actuated tilt means coupled to said bucket for selectively imparting tilting movement thereto about its pivot connections to said lift arms, a cross beam transversely interconnecting said lever arms at a position intermediate the pivot connections of said lever arms to said frame and the pivot connections of said lift arms to said lever arms, said lever arms having raised stops on the rear edges thereof adjacent the pivot connections of the rod ends of said first pair of jacks thereto for abutting said frame when said lever arms are in said second position thereof, said lift arms having outwardly projecting stops on the rear edges thereof at positions spaced forwardly from the pivot connections of said lift arms to said lever arms for abutting said cross beam when said lift arms are in lowered position, whereby said first and second hydraulic jack means are actuated to effect correlated pivotal movement of said lever arms and lift arms commensurate with lift travel of said bucket from ground level upwardly through three interconnected arcs approximating a vertical line and said tilt means are actuated to tilt said bucket between load, carry, and dump positions.

3. End loader linkage for effecting lift travel of a bucket on a vehicle having a frame and wheels comprising a pair of transversely spaced parallel lever arms pivotally connected to and upwardly projecting from the front frame of said vehicle at points rearwardly displaced from the rotational axis of the front wheels thereof, a pair of transversely spaced parallel lift arms having first ends pivotally connected to said lever arms and second ends pivotally connected to said bucket, the pivot connections of said lift arms to said lever arms being downwardly displaced from the free ends of said lever arms, first hydraulic jack means including a pair of substantially horizontally disposed hydraulic jacks pivotally connected to said front frame at points rearwardly displaced from the pivot connections of said lever arms to said frame and having their rod ends pivotally connected to said lever arms at points upwardly adjacent their pivot connections to said frame, second hydraulic jack means including a second pair of hydraulic jacks pivotally connected to said frame at points forwardly displaced from the pivot connections of said lever arms thereto and having their rod ends pivotally connected to said lift arms, said second pair of jacks being substantially vertically disposed when said lever arms are in said first positions thereof, and hydraulically actuated tilt means coupled to said bucket for selectively imparting tilting movement thereto about its pivot connections to said lift arms said tilt means comprising a pair of levers having first ends pivotally connected to said lift arms at points rearwardly adjacent said bucket, a pair of links having opposite ends respectively pivotally connected to the second ends of said levers and said bucket, and a third pair of hydraulic jacks pivotally connected at their cylinder ends to the free ends of said lever arms and having their rod ends pivotally connected to said levers at points intermediate their ends, whereby said first and second jack means are actuated to effect correlated pivotal movement of said lever arms and lift arms commensurate with lift travel of said bucket from ground level upwardly through three interconnected arcs approximating a vertical line and said tilt means are actuated to tilt said bucket between load, carry and dump positions.

4. Linkage according to claim 3, further defined by a cross beam transversely interconnecting said lever arms at a position intermediate the pivot connections of said lever arms to said frame and the pivot connections of said lift arms to said lever arms, said lever arms having raised stops on the rear edges thereof adjacent the pivot connections of the rod ends of said first pair of jacks thereto for abutting said frame when said lever arms are in said second position thereof, said lift arms having outwardly projecting stops on the rear edges thereof at positions spaced forwardly from the pivot connections of said lift arms to said lever arms for abutting said cross beam when said lift arms are in lowered position.

* * * * *