This invention relates to a front end loader, and more particularly to a front end loader which may be either wheel or crawler-mounted and equipped with power means for providing horizontal forward crowding at the ground line while utilizing a single power source to raise the excavating bucket to maximum elevation.

In conventional front loaders, the forwardly-opening excavating bucket is usually moved forward adjacent to the ground line by advancing the tractor or crawler itself; and in instances where the bucket may be moved forward by separate power means, complicated support mechanism requires several operations and the utilization of several power means for raising the bucket to maximum elevation.

We have discovered that a front end loader equipped with an inner boom and an outer boom in jackknife relation may be mounted upon a vehicle and power means provided whereby actuation of the power means provides a horizontal forward crowding of the excavating bucket while at the same time permitting rapid elevation of the bucket to its maximum elevation through the use of single power cylinder means. This is accomplished through the use of two power cylinders which are controlled for operation in unison for providing the forward horizontal crowding movement while only one of the power means is required for rapidly swinging the bucket to a maximum elevation.

A primary object, therefore, is to provide a front end loader, either wheel or crawler-mounted, having an inner and outer boom in jackknife relationship, with power means effective for moving an excavating bucket in a forward, horizontal crowding line, without moving the loader while at the same time permitting rapid elevation of the bucket to maximum height in a single operation. A further object is to provide in such a structure hydraulic circuit control means in which the discharge from one power cylinder feeds into the input side of a second hydraulic cylinder whereby the piston rod means of the cylinders are moved simultaneously and in unison to provide horizontal forward crowding movement at the ground line. A still further object is to provide in such a structure means by which a single one of such power cylinder means may be actuated for raising the bucket to maximum elevation. Yet another object is to provide in such a structure a parallelogram arrangement of the outer boom with a rigid tension member, both being mounted upon an inner boom pivotally anchored at its lower end on the base of the machine chassis, and with the excavating bucket supported upon said outer boom.

Another object is to provide a vehicle in which inner and outer booms are actuated by hydraulic cylinders which are so related to each other that controlled and simultaneous piston rod movement in leaning the inner boom outward and hinging the outer boom away from the inner boom produces horizontal movement at the lower end of the outer boom where the bucket is attached and permits below ground excavation by forward tilting of the inner boom. Other specific objects and advantages will appear as the specification proceeds.

The invention is shown, in illustrative embodiments, by the accompanying drawings, in which:

FIGURE 1 is a perspective view of a wheel-equipped vehicle or tractor equipped with apparatus embodying our invention; FIG. 2A, a side view of the apparatus shown in FIG. 1, with the excavating bucket raised to elevated position; FIG. 2B, a portion of the structure shown in FIG. 2A but showing the bucket in lowered, crowding position; FIG. 3, a schematic view showing the hydraulic control system for operating the power cylinders separately and selectively and also simultaneously and in unison; FIG. 4A, a side view in elevation of the structure shown in FIG. 2A with the bucket in elevation but with the mechanism mounted upon the turret structure of a crawler-type of vehicle; and FIG. 4B, a portion of the structure shown in FIG. 4A but comprising the apparatus in lower, crowding position.

In the illustration given in FIGS. 1, 2A and 2B, 10 designates a wheel-equipped vehicle or the track or tractor type. To the brackets 11 mounted on the forward end of the vehicle are pivotally secured the inner boom members 12. The inner boom members are connected at their tops by a pivot pin 13. The two pivoted members 12 comprise a forward tiltable support or mast, which is referred to herein as the inner boom.

An outer boom 14 is provided by two spaced members connected by a pivot 15 to the inner boom members at a point below the upper pivot 13. The outer boom 14 is shown provided with a rigid tension member or link 16 also pivotally carried at the top of the inner boom 12 by the pivot 13. At the bottom of the link 16 is an inverted, U-shaped connector 17 pivotally mounted by a pin 18 upon a pair of bell crank members 19.

A conventional forwardly-opening excavating bucket 20 is supported upon the lower end of the inner boom members 14, the bucket being pivotally carried upon the arm 21 mounted by pivot 22 upon the outer boom 14. The bucket may be supported and operated by conventional support mechanism such as the pivot links 23 and support links 24. A power cylinder 25 is trunnion-mounted and supported upon the bell crank members 19 and the piston 26 is effective for positioning the excavating bucket for crowding, lifting and dumping, as illustrated in the drawings. Since such structure is conventional and well known, a further detailed description is believed unnecessary.

For operating the inner and outer boom members, we provide hydraulic piston-equipped power cylinders together with control mechanism for the actuation of the cylinders. Two spaced cylinders 27 are pivotally supported at their inner ends to the standards 28 carried by the vehicle 10. The pistons of the cylinders are connected to the pivot rod 15 which passes through the inner boom members 12.

Between the members 12 which comprise the inner boom, is mounted a trunnion 29 supporting a hydraulic cylinder 30 within bracket 29u. For ease of identification, the hydraulic cylinder 30 is referred to herein as the crowd cylinder, and the two cylinders 27 are referred to as hoist cylinders. The piston of cylinder 30 is secured to a pivot ring 31 engaging pivot pin 32 which passes through the members 14 of the outer boom.

Hydraulic control means are provided for causing the hoist cylinders and the crowd cylinder to operate independently and in unison, the arrangement being such that, for a horizontal crowding movement, which is illustrated in FIG. 2B, both cylinder means may be operated simultaneously to cause the actuating levers to move outwardly in unison, effecting the crowding action illustrated in FIG. 2B. Further, with such structure, the crowd cylinder 30 may be left in the position shown in FIG. 2A and the hoist cylinder 27 may be actuated alone to bring about the quick vertical movement to the position of maximum elevation shown in FIG. 2A.

Any suitable hydraulic control mechanism may be employed. In the schematic view shown in FIG. 3, the hoist cylinder 27 is shown with hydraulic liquid connections at
its two ends. Similar connections are shown for the double-acting crowd cylinder 30. The valve body 33 of FIG. 3 shows flow lines with a spool valve 34 mounted in one control recess and a spool valve 35 mounted in a similar control recess. Actuating levers 36 and 37 are provided for manipulating the spools separately, and a member 38 is shown for operating the levers 36 and 37 simultaneously and in unison. The hydraulic fluid is supplied from the pump 39 and the released fluid passes outwards by a supply tank 40. Since the valve mechanism is old in itself, a further detailed description is believed unnecessary.

In the above hydraulic valve mechanism, reciprocation in a vertical plane of either of the spool valves 34 and 35 diverts oil from the pump into the end of the valve casing and toward which the spool valve is moved, and oil flows from the pump through one end of the cylinder 27 or 30 and from the other end of the cylinder flows back through the valve which is opened at the top of the valve by the grooved upper portion of the spool valve. When both the valves 36 and 37 are actuated by moving the member 38 downwardly, the hydraulic fluid flows similarly first through the cylinder 27 and thence back through the flow passages to the second valve 35 which, being similarly actuated, passes the fluid to the cylinder 30, and from the cylinder the oil returns passing through the deep groove of the depressed spool valve and thence outwardly to the tank.

The use of the valve is important in permitting the operation of the hoist cylinder and crowd cylinder separately, while also enabling the two cylinders to be operated simultaneously and with even movement by passing the fluid in series so that the discharge from the hoist cylinder feeds the input side of the crowd cylinder. With the pistons of the two cylinder means moving in unison, an effective crowding action takes place, as illustrated in FIG. 2B, while utilizing the power of both of the cylinders means 27 and 30. Furthermore, as above stated, the control permits utilizing the hoist cylinder 27 for bringing the outer boom in a single operation to its maximum elevation, as shown in FIG. 2A.

Operation

In the operation of the apparatus shown in FIGS. 1–3, inclusive, the power cylinder means 27 and 30 may be manipulated separately through the control mechanism shown in FIG. 3 to bring the excavating bucket 20 to the position shown in solid lines in FIG. 2B. To effect forward crowding movement along the ground line, the control 38 is moved downwardly to produce flow of the hydraulic fluid from the pump to the two cylinders in series, with the fluid passing through the hoist cylinder 27 and the returning fluid from the rod end of the hoist cylinder 27 being diverted to the anchor end of the crowd cylinder 30, whereby the piston rods of both cylinders move outwards simultaneously and in unison to effect the crowding movement shown in dotted lines in FIG. 2B. The bucket can then be swung by operation of the bucket cylinder 25 to an upright position as illustrated in solid lines in FIG. 2A and the bucket, with its load elevated to the position shown in FIG. 2A by the action of the hoist cylinder 27. The bucket 20 may then be dumped, as shown in dotted lines in FIG. 2A, by the action of cylinder 25.

In the operation just described, it will be noted that both cylinder means, namely, 27 and 30, are utilized in FIGS. 4A and 4B, the parts shown in dotted lines in FIG. 2B where the vehicle remains still and great power is required in the movement of the bucket through the engaged material, while for elevation one of the two cylinder means, namely, 27, need only be used in effecting a rapid vertical elevation of the material.

In FIGS. 4A and 4B, the parts shown are substantially those already described in connection with FIGS. 1, 2A and 2B, but such structure is here mounted upon a turret 41 mounted upon a crawler-advancing mechanism 42.

The parts shown in FIGS. 4A and 4B are designated with the same numerals followed by the letter "b" as those employed in FIGS. 1, 2A and 2B, and the operation of such parts is the same as that heretofore described in connection with FIGS. 1, 2A and 2B.

While in the foregoing specification we have set out specific structure in considerable detail for the purpose of illustrating embodiments of the invention, it will be understood that such details may be varied by those skilled in the art without departing from the spirit of our invention.

We claim:

1. A front end loader, comprising a vehicle having an inner boom pivotally mounted thereon and an outer boom pivotally mounted on the upper end portion of the inner boom in jackknife relation, said outer boom being provided at its lower end with a forwardly-opening excavating bucket, power cylinder means mounted on said vehicle for actuating said outer boom, power cylinder means mounted on said outer boom, control means for actuating said power cylinders in unison to provide horizontal forward crowding of said bucket and for separately actuating only one of said power cylinder means for elevating said bucket to its maximum elevation.

2. The structure of claim 1 in which the hydraulic fluid flow actuating the cylinders is in series, with the discharge of one cylinder feeding the input side of the second cylinder.

3. The structure as described in claim 1 in which the cylinders actuating the inner and outer booms are controlled by adjacent hand levers in a series hydraulic circuit in which the discharge from the first cylinder feeds the input side of the second cylinder, whereby the piston rod movement of the cylinders is simultaneous and in unison to produce substantially horizontal crowd.

4. A front end loader, comprising a vehicle, an inner boom pivotally anchored at its lower end on said vehicle, power cylinder means mounted on said vehicle for moving said boom on said pivot, an outer boom pivotally mounted on the upper portion of said inner boom in jackknife relation, a rigid parallel link pivotally mounted on the upper end of said inner boom above the pivotal connection with said outer boom, a bell crank at the lower end of said outer boom pivotally connecting said outer boom and link, a forwardly-opening excavating bucket hinged upon the lower end of said outer boom, power cylinder means carried by said outer boom for lifting said bucket, and power cylinder means carried by said inner boom for actuating said outer boom, control means being provided for operating said power cylinder means actuating said booms separately and in unison.

5. A structure as described in claim 4 in which said parallel link is hinged to the top of said inner boom and above the pivotal connection between said inner boom and outer boom.

6. A front end loader as described in claim 1 in which the vehicle is wheel-mounted.

7. A front end loader as described in claim 1 in which the vehicle is crawler-mounted.

8. In a vehicle equipped at the front part thereof with fixed supports, an inner boom pivotally anchored at its lower end on said supports, an outer boom pivotally mounted on said inner boom below the upper end of the inner boom and in jackknife relation therewith said outer boom being provided with an excavating bucket, power means mounted on said vehicle for tilting said inner boom forwardly and inwardly, power means mounted on said inner boom for moving said outer boom forwardly and inwardly, said booms being positioned relative to each other so that simultaneous piston movement in said inner boom and said outer boom outwardly in moving the outer boom away from the inner boom, produces horizontal movement at the lower end of the outer boom for crowding movement of said bucket.
9. The structure of claim 8 in which the two booms are controlled by hydraulic cylinders and hydraulic fluid control means cause flow selectively through the separate cylinders and flow selectively to both cylinders for simultaneous movement of the two cylinder pistons in unison.

10. A front end loader mounted upon a vehicle and comprising an inner and an outer boom in pivotally connected jackknife relation and with a forwardly-opening excavating bucket mounted upon the lower end of the outer boom, power means mounted on the lower end of the outer boom for tilting said bucket, power cylinders for moving said inner boom outwardly and said outer boom upwardly, a rigid parallel link extending between the upper end of the inner boom above the pivotal connection between said inner and outer booms and to a lower portion of the outer boom, a bell crank connecting said link in parallel with the lower end of said outer boom for maintaining horizontal bucket crowd with simultaneous extension of the booms by said power actuating means.

11. In a front end loader vehicle, an inner boom pivotally mounted at its lower end of said vehicle and pivotally connected at its upper end with a rigid parallel link, an outer boom pivotally mounted on said inner boom below said connection with said rigid link and pivotally connected at its lower end with said rigid link, a forwardly-opening excavating bucket hinged upon the lower end of said outer boom and said link, hydraulic power means mounted on said vehicle and equipped with a piston rod pivotally engaging said outer boom at its point of connection with said inner boom, hydraulic power means carried by said inner boom for actuating said outer boom, and control means for actuating said power cylinder means in unison for maintaining horizontal bucket crowd with simultaneous extension of the booms by said power actuating means.

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