EXCAVATING AND LOADING ATTACHMENT FOR TRACTORS

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The invention relates to attachments of the swinging boom type for adapting tractors and comparable transport vehicles for excavating or loading operations and it is more particularly concerned with improved means for supporting and actuating the shovel or bucket constituting the digging and load carrying element of the attachment.

One object of the invention is to provide a bucket supporting and actuating linkage for attachments of the above general character capable of imparting a forward cutting movement as well as an upward swinging movement to the bucket, thereby enabling the latter to effect a digging action while the vehicle on which it is mounted remains stationary.

Another object is to provide a bucket supporting and actuating linkage which increases the effective digging range of the attachment and which permits excavating well below the level at which the vehicle is supported.

Still another object is to provide a bucket supporting and actuating linkage which allows more space for the operator at the front of the vehicle and which affords greater clearance for the front wheels of the vehicle. A related object is to provide a linkage which permits the bucket to be located very close to the front axle of the supporting vehicle, thereby enabling the vehicle to more effectively balance the forces exerted on the bucket in digging and permit the use of substantially greater forces without raising the vehicle from the ground.

A further object is to provide a supporting and actuating linkage which permits power to be applied to the bucket in a manner affording more efficient operation. A more specific object is to provide a linkage which automatically adjusts to minimum length so that maximum force can be exerted on the cutting edge of the bucket when it is in a lowered or digging position and which extends to afford maximum dumping reach when the bucket is raised.

An ancillary object is to provide a linkage operative to automatically roll forward the bucket to eliminate spillage as the bucket is raised toward an elevated dumping position.

It is also an object of the invention to provide an excavating and loading attachment for vehicles characterized by the high degree of rigidity of the load carrying members and of the frame structure by which it is mounted on the vehicle.

Other objects and advantages of the invention will become apparent from the following detailed description of the preferred embodiment illustrated in the accompanying drawings, in which

FIGURE 1 is a side elevational view of an attachment embodying the features of the invention shown as mounted on a tractor type transport vehicle.

FIG. 2 is a fragmentary top view of the tractor and attachment shown in FIG. 1.

FIG. 3 is a partly sectioned front view of the attachment and tractor shown in FIG. 1.

FIG. 4 is a fragmentary side view showing the bucket of the attachment raised substantially midway between digging and dumping positions.

FIG. 5 is a fragmentary side view showing the bucket of the attachment in its lower digging position.

While a preferred embodiment of the invention and its application to a specific form of tractor have been shown by way of illustration, it is to be understood that it is not intended to limit the invention to that particular embodiment or the application, the intention being to cover all modifications and adaptations falling within the spirit and scope of the invention as more broadly or generally characterized in the appended claims.

Referring to the drawings, the invention has been shown embodied in an attachment A for performing digging, loading and comparable operations. For convenient identification, the elements constituting the attachment have been shown in solid lines in the various figures, while the tractor T upon which the attachment is mounted is shown in broken lines. The particular tractor shown has an elongated body 10 supported at one end by a pair of relatively large rubber treaded drive wheels 11 and at the other end by a pair of smaller rubber treaded wheels 12 by which the tractor is steered. The drive wheels are mounted on axle housings 13 extending from opposite sides of the tractor body.

The tractor T as shown is a conventional tractor modified to reverse its ends, that is, what normally constitutes the rear end becomes the front insofar as the operation of the attachment is concerned. This involves the reversal of the driver's seat 14 and the relocation of the steering wheel and certain other controls in well-known manner.

The attachment A includes a frame adapted to be secured to the tractor body. As shown, the frame comprises a pair of generally triangular side members 20 arranged with their bases resting on pads conventionally provided on the tractor axle housings 13 and secured thereto by clamping plates and bolts. Side balls 22 rigid with and extending rearwardly from the members 20 are preferably bent inwardly as in FIG. 2 to fit closely against the sides of the tractor body and are secured in place thereon by bolts or other suitable fasteners.

The frame members 20, which may conveniently comprise heavy flange steel plates, are dimensioned to extend upwardly a substantial distance above the tractor front axle and provide a supporting structure for a swinging boom as will appear presently. The members are shaped so as to present substantially vertical front edges aligned with the forward edge of the axle housings 13 to provide greater strength and rigidity, the supporting structure is reinforced by plates 26 and 27 (FIG. 3) extending between the members 20 and welded or otherwise rigidly secured thereto.

In accordance with the invention, the swinging boom is constructed in the form of a hinged or articulated arm comprising an upper section 25 and a lower section 26 hinged together and respectively connected to the support frame 20 and to a load device 27. As shown herein, the upper boom section is substantially longer than the lower section and comprises spaced parallel bars 30. At their upper ends the bars 30 are pivotally connected to the supporting structure by pivot pins 33 extending through aligned apertures in the bars and in yoke elements 34 welded to the side members 20 adjacent their upper ends. As will be seen by reference to FIGS. 1 and 2, the yoke elements project forwardly of the frame structure and locate the pivotal axis of the boom with respect to the front of the support structure so that the boom may be swung into a substantially vertical position. This locates the lower digging position of the attachment very close to the front end of the tractor and permits application of maximum force in a direction to force the digging element into the ground.

Power actuated means is provided for swinging the boom 25 from the lower limit position in which it is shown in full lines in FIG. 1 to an upper limit or "dumping" position shown in broken lines in that figure. The power actuated means preferably comprises a pair of hydraulic actuators or rams 35 acting between the attach-
ment frame and the respective side members of the boom. The rams are alike and are similarly mounted, each comprising a cylinder 36 pivotally anchored adjacent its open end to a bracket 37 rigidly secured to one of the frame side members 20. The cylinder is fitted with the usual working piston connected by a piston rod 38 with one of the side bars 30. The connection is provided in this instance by a yoke 39 of the projecting end of the piston rod which straddles a triangular bracket 40 rigid with the respective bars 30. The yoke and bracket are connected by a pivot pin 41. Fluid such as oil under pressure supplied from a suitable source on the tractor and delivered to the closed ends of the cylinders 36 forces their pistons rearwards so that the boom swings through and upwards. When fluid is allowed to exhaust from the cylinders, the boom descends under the weight of its load.

The lower section 26 of the boom as shown in FIGS. 1 and 2 comprises a pair of elongated generally triangular side members 45 disposed in parallel relation. A pair of pivot pins 43 are inserted through the side members and are welded thereto to form a rigid structure. Preferably the side members 45 are spaced apart to allow them to fit between the side bars 30 of the upper boom section 25 and the inner ends of the side members are pivotally secured to the bars adjacent their lower ends by pins 52. At its outer end, the bucket 47 supports the load device 27 herein shown as a shovelfor digging or loading.

To increase the versatility and efficiency of the attachment for digging and loading operations, provision is made for varying the angular relationship between the upper and lower sections of the boom as it swings through its operating arc. This is accomplished by means of a link which may be of fixed or variable length. In the exemplary embodiment, the lower boom section 26 is connected by a rigid link 50 with the frame structure of the attachment. This connection is effected through the medium of a pivot pin 51 (FIG. 2) inserted through aligned apertures in a pair of spaced ears 52 welded to the front cross member 46 of the boom section 26 substantially midway of its ends. The connection with the frame as shown in FIGS. 2 and 3 is effected by a pivot pin 53 inserted through spaced ears 56 rigid with and projecting upwardly and forwardly from a cross member 55 extending across the upper ends of the frame members 29.

The geometry of the various pivot connections, that is, the location of the pivots for the link 50 with respect to the pivots for the upper and lower boom sections is the important consideration here. More particularly, the pivot for the upper boom section is tracted and the effective overall length of the boom is reduced to a minimum when the boom is swung to its lower or digging position as shown in FIGS. 1 and 4. The leverage ratio thus provided enables the power of the actuator 35 to be applied most effectively when it is actuated as at the instant of the initiation of digging.

As the boom swings upwardly so that spillage of the load is effectually prevented. Pressure fluid for operating the actuators 62 is supplied from a source on the tractor through suitable controls mounted within the easy reach of the tractor driver.

While the loading of the bucket 27 may be made in the conventional manner by forward movement of the boom, the novel linkage support provided by the improved boom structure above described permits loading to be effected by application of the hydraulic power while the tractor remains stationary. Assume, for example, that material is to be removed from a soil bank or the like indicated as at 79 in FIG. 1. With the boom swung to its lower limit position and the bucket 27 allowed to tilt forward until its cutting edge is substantially at ground level, the tractor is moved ahead to bring the bucket to the base of the soil bank to be excavated. The tractor is then stopped, leaving the operator free to manipulate the controls for the hydraulic actuators. Upon delivery of pressure fluid to the actuators 35, the boom is swung forwardly forcing the cutting edge of the bucket into the soil bank. As the boom rises the cutting edge of the bucket is carried upwardly and forwardly. If the boom were of rigid one-piece construction, the cutting edge of the bucket would move along a path indicated by the arcuate broken line X in FIG. 4. However, due to the articulated construction of the boom, the provision for rocking the lower section clockwise as the boom swings upwardly, an increment Y of forward movement is imparted to the bucket and its cutting edge accordingly moves along a path indicated by the arcuate broken line Z. Thus, the articulated construction of the boom, coupled with the novel mounting on the tractor, improves the digging action of the attachment and increases the dumping range.

The pivoting of the boom forwardly of the tractor front axle is also advantageous in that it permits the digging to be done quite close to the tractor and allows the equipment to be used in cramped spaces. Moreover, it permits digging below the level at which the tractor is supported. For example, the bucket may be tilted as shown in FIG. 5 as the tractor advances a short distance to drive the cutting edge into the ground. The boom may then be raised through the action of the hydraulic actuator to scoop out a full load.

When used for either digging or loading, the boom is extended to the maximum length as the bucket is raised to dumping position. This permits excavated material to be piled higher or to be dumped farther from the tractor than is possible by conventional bucket mountings. It will be apparent from the foregoing that the inven-
tion provides a digging and loading attachment for tractors, which, while simple and rugged in construction, is efficient and versatile in operation. The linkage structure provided by the invention for supporting the bucket materially increases the digging ability of the attachment and it also extends the dumping range so that material can be piled higher or dumped farther from the point of excavation. The improved mounting also enables the attachment to dig close to the vehicle on which the attachment is mounted. Due to the close approach of the bucket to the tractor, greater downward pressure may be exerted when digging without raising the tractor from the ground.

I claim as my invention:

1. An attachment for tractors comprising, in combination, a frame adapted to be mounted on a tractor, an elongated boom comprising a pair of rigid sections hinged together, means pivotally supporting one section of the boom adjacent its free end on said frame to swing in a vertical plane between a lowered substantially vertical digging position and a raised dumping position, a load device pivotally mounted at the free end of the other boom section, a rigid link connected between said frame and said other boom section operative to vary the angular relation of the sections so that the length of the lever arm defined by the boom is reduced to a minimum when the boom is in the digging position and is increased to a maximum when the boom is raised to dumping position.

2. An attachment for tractors comprising, in combination, a frame adapted to be mounted on a tractor, an elongated boom comprising a pair of rigid sections hinged together, means pivotally supporting one section of the boom adjacent its free end on said frame to swing in a vertical plane between a lower substantially vertical digging position and a raised dumping position, a load device pivotally mounted at the free end of the other boom section, a rigid link connected between said frame and said other boom section operative to vary the angular relation of the sections so as to impart a forward initial digging thrust to the load device as the boom is swung upwardly from the lower position.

3. An attachment for tractors comprising, in combination, a frame adapted to be mounted on a tractor and having an upward extension located adjacent the front end of the tractor, a boom including an elongated upper section having one end pivotally mounted on said extension to swing about a generally horizontal axis located so as to allow the boom to swing down to a substantially vertical position, an elongated lower section pivot at one end on said upper section adjacent its free end, a rigid link pivotally mounted adjacent the free end of said lower section, a hydraulic actuator connected between said upper section and said bucket operable to tilt the bucket between digging and load carrying positions, and a rigid link pivotally connected respectively to said lower section and to said frame, the pivot connections of said link being located relative to the pivots for said sections so that said lower section is rocked in a direction to impart a forward movement to the front edge of said bucket incident to the upward swinging of said boom from the vertical position.

4. An attachment for tractors comprising, in combination, a frame adapted to be mounted on a tractor and having an upward extension located adjacent the front end of the tractor, an elongated boom including an upper section having one end pivotally mounted on said extension to swing about a generally horizontal axis located so as to allow the boom to swing down to a substantially vertical position, an elongated lower section pivot at one end on said upper section adjacent its free end, a rigid link pivotally mounted at one end to said frame and at the other end to said lower section, the pivot on said frame being located above and to the rear of the pivot for the upper section on said frame, a bucket pivotally mounted on the free end of said lower section, a hydraulic actuator connected between said upper section and said bucket operative to tilt the bucket between a forwardly tipped digging position and an upright load carrying position, said link being operative in the upward swinging of said boom to rock said lower section in a direction to maintain the bucket in substantially the posture in which it was initially positioned by said actuator.

5. An attachment for tractors comprising, in combination, a support structure adapted to be mounted on a tractor and to extend upwardly adjacent the front end of the tractor, an elongated boom pivotally mounted at its free end to swing about a transverse axis between a substantially vertical lower position and an inclined raised position above a horizontal plane through the pivot axis, said boom having a lower section pivotally connected to the pivot of the boom, a load carrying bucket pivotally mounted at the free end of said lower boom section, a rigid link pivotally connected at opposite ends to said lower boom section and to said support structure, said link being pivotally connected at one end to the rear of the pivot axis of said boom and projecting therefrom at an angle with said boom, the opposite end of said link being pivotally connected to said lower section forwardly of the pivotal connection between the upper and lower boom sections so as to position the same substantially at right angles to the upper section when the boom is in its lower position, said link being further operative to swing the lower boom section toward parallelism with the upper portion of the boom as the latter is swung toward the raised position, and power actuated means operable to rock the bucket on its pivot between loading and carrying positions.

References Cited in the file of this patent

UNITED STATES PATENTS

2,799,410 Carlson ------------------- July 16, 1957
2,808,017 Killebrew ----------------- Oct. 1, 1957
2,978,124 Bernatos ----------------- Apr. 4, 1961
3,019,922 Webster ------------------- Feb. 6, 1962

FOREIGN PATENTS

1,109,751 France ------------------- Sept. 28, 1955