United States Patent [19]

Briggs

[11] **3,746,150**

[45] **July 17, 1973**

[54] **BULK MATERIAL HANDLING APPARATUS**

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[73] Assignee: **Dravo Corporation,** Pittsburgh, Pa.

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[52] **U.S. Cl.** **198/233,** 214/10

[51] **Int. Cl.** **B65g 41/00**

[58] **Field of Search** 214/10; 198/233, 198/36

[56] **References Cited**

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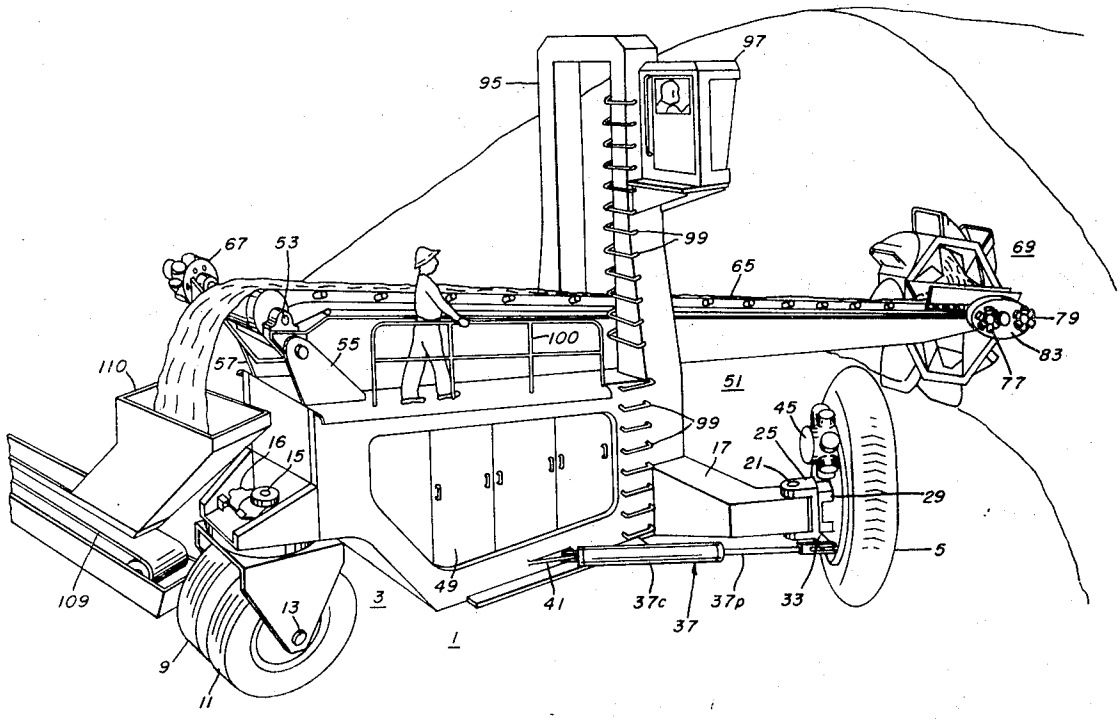
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Primary Examiner—Evon C. Blunk
Assistant Examiner—Hadd S. Lane
Attorney—Richard V. Westerhoff

[57] **ABSTRACT**

A bulk material handler is supported by a pivotable truck and two independently steerable and independently driven main wheels which stradle a loader equipped boom. For movement in a direction generally parallel to the boom, the main wheels are turned in synchronism in parallel planes. For slewing, the main wheels are turned in opposite directions until their rolling axes intersect the turning axis of the truck. For linear movement transverse to the boom, the main wheels are turned until their rolling axes are parallel to the boom. The vertically rotatable boom is pivoted at a point above the turning axis of the truck.

5 Claims, 7 Drawing Figures



4 Sheets-Sheet 1

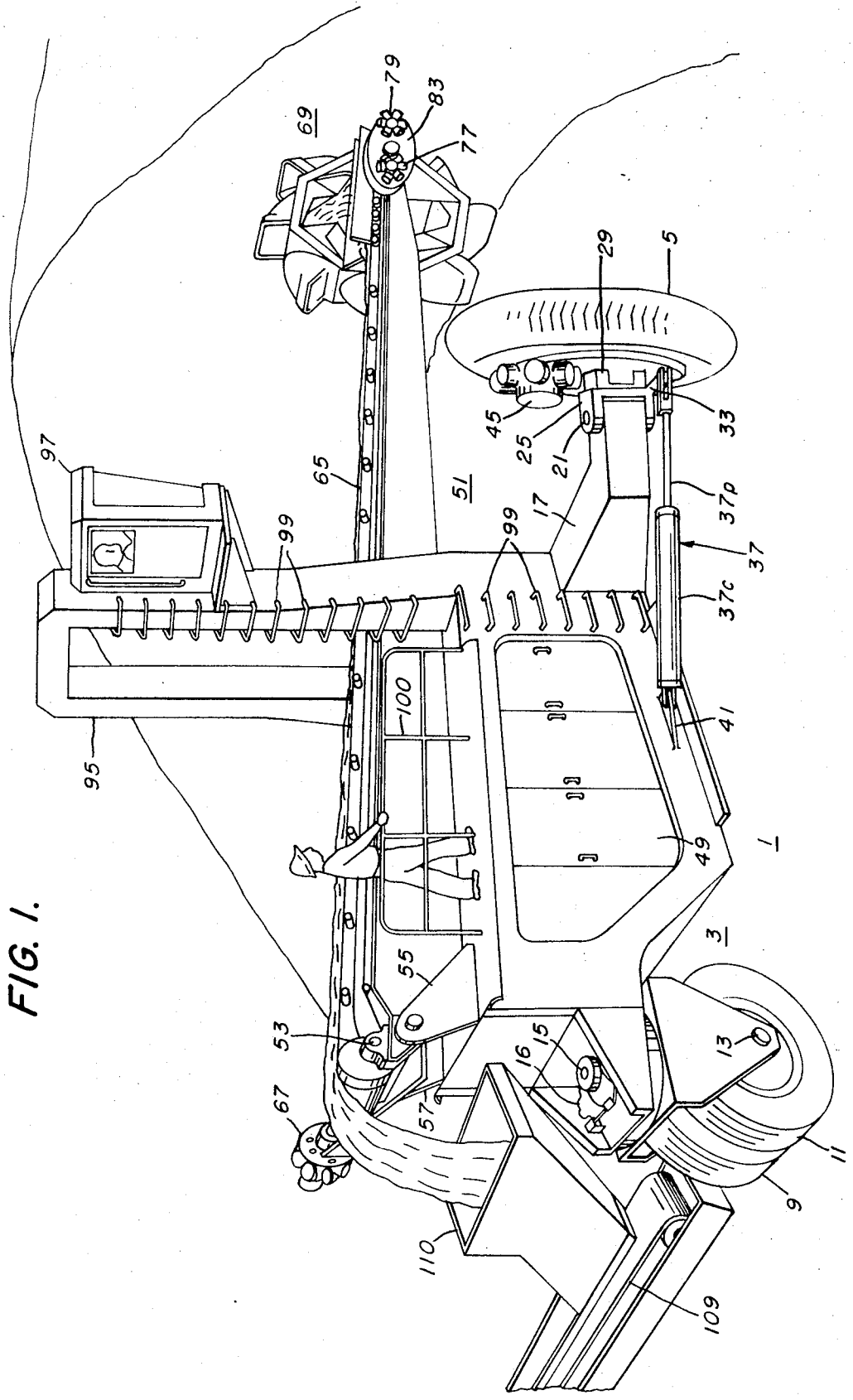


FIG. 1.

FIG. 2.

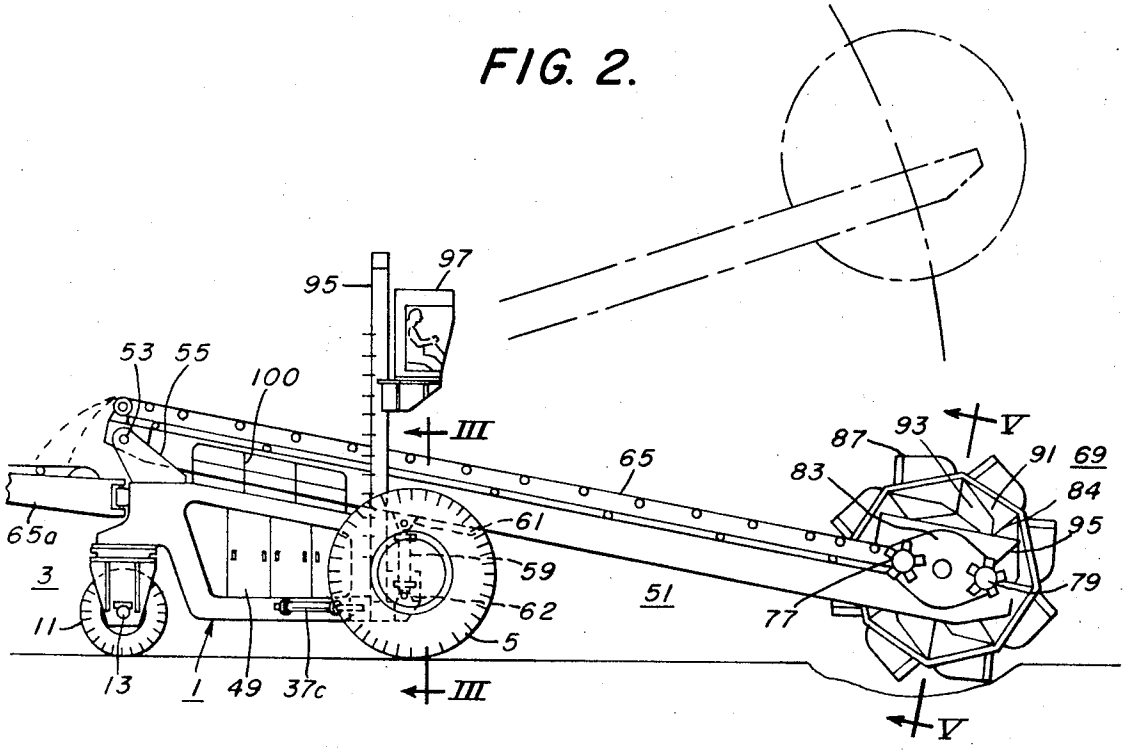

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FIG. 3.

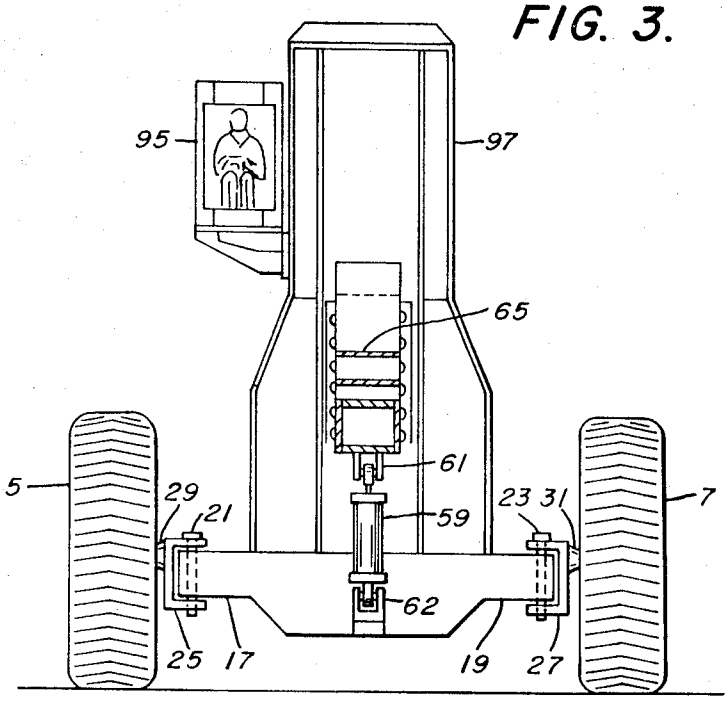

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FIG. 4.

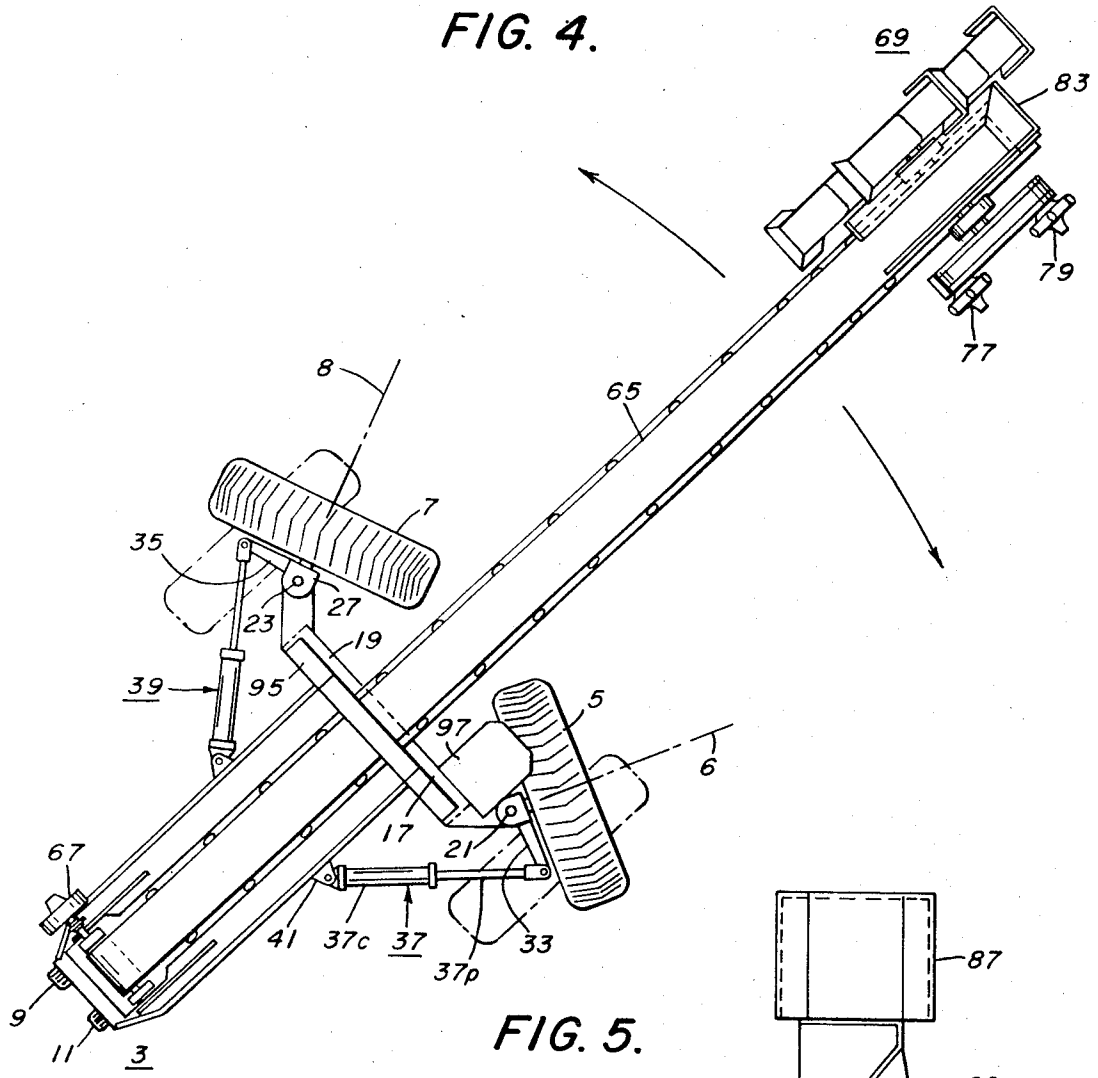

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FIG. 5.

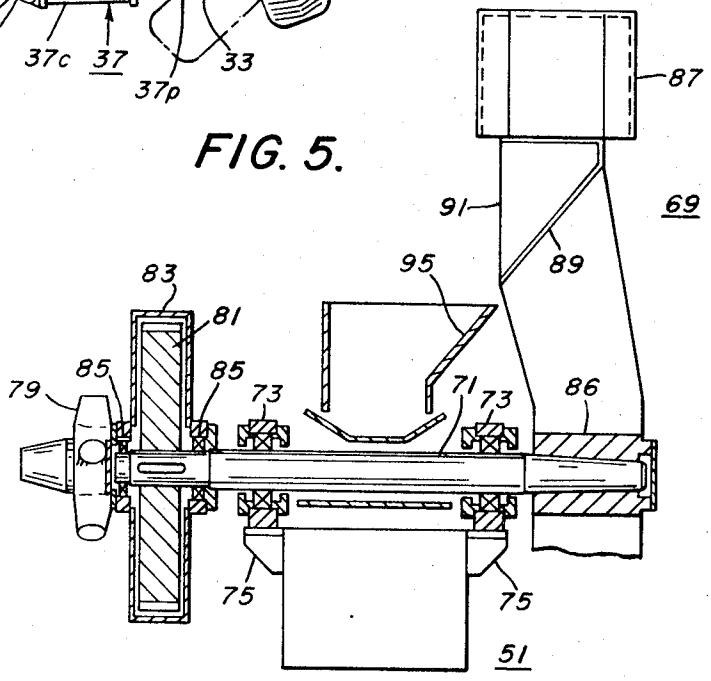

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FIG. 6.

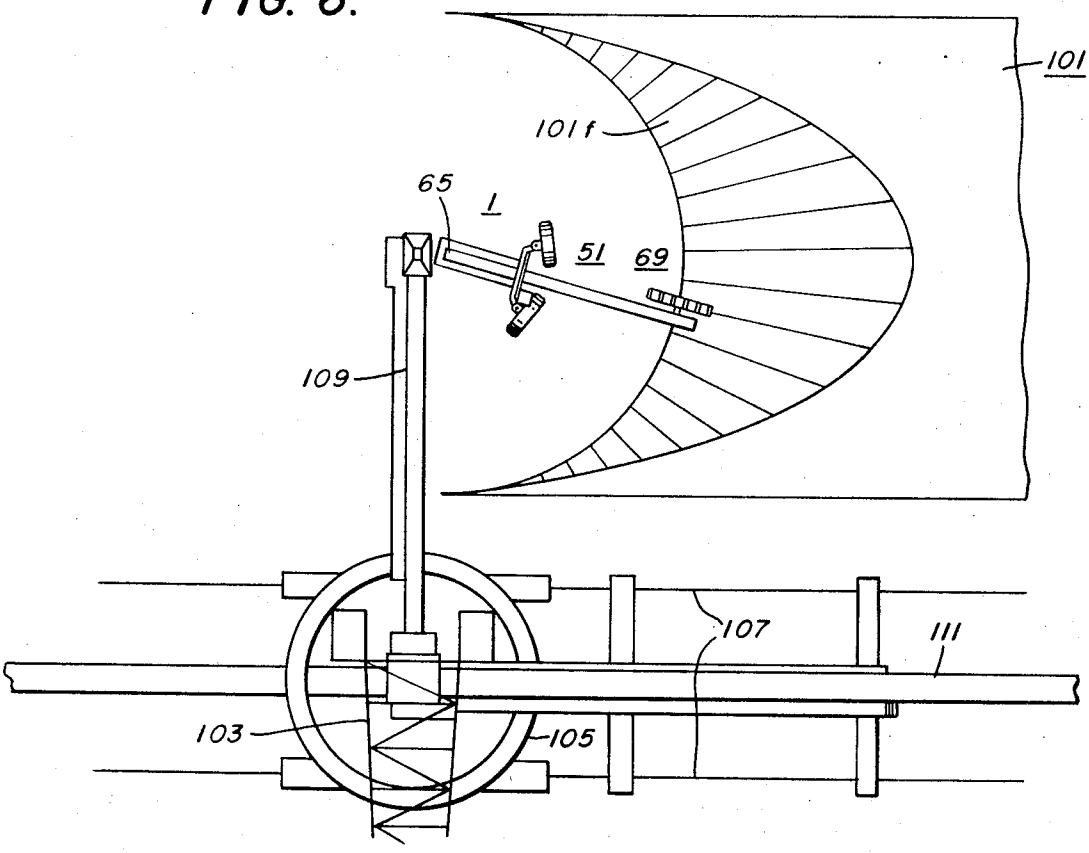
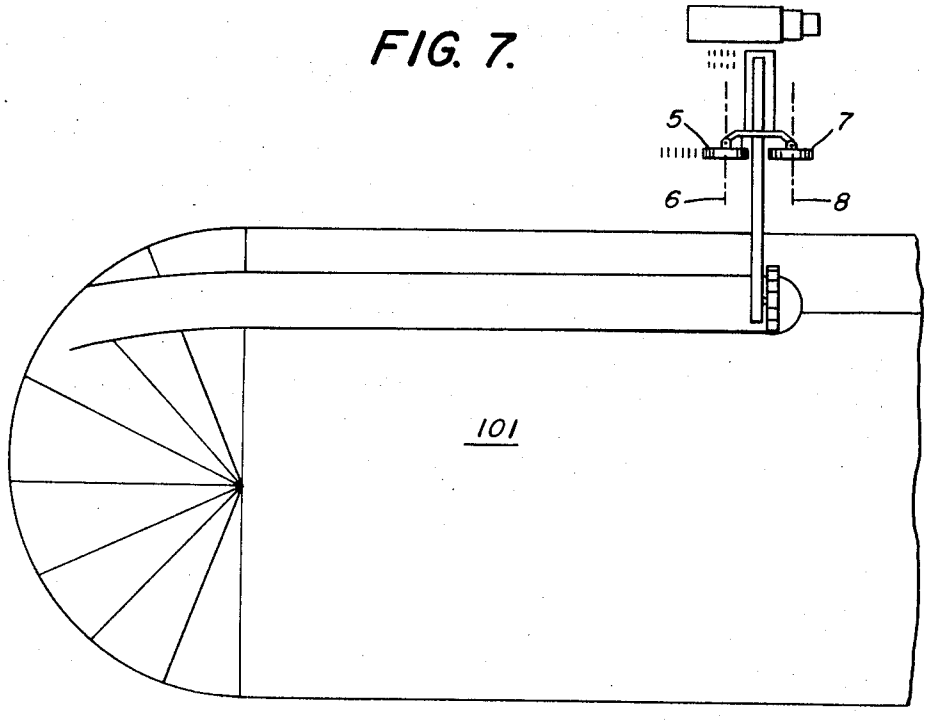


FIG. 7.



BULK MATERIAL HANDLING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to bulk material handlers such as excavators and reclaimers used for recovering particulate matter from stock piles, and more particularly, to self-propelled excavators and reclaimers which operate independently of any fixed structure.

2. Prior Art

In recovering particulate matter such as coal, ores etc. from stock piles, it is necessary that the loading element be advanced as the stock pile is consumed. This is also true of excavators. There are generally two types of reclaimers which perform this function. In one type, a bridge or boom carrying the loading element moves along a fixed structure, commonly on steel rails. An example of this type of reclaimer is disclosed in U.S. Pat. No. 1,856,118, in which a boom structure for stacking and reclaiming pulp wood moves in an arcuate path on steel rails. In the other type of reclaimer, the device operates independently of any fixed structure. This invention relates to the latter type of reclaimer and similar types of excavators.

Commonly, these bulk material handlers are mounted on a bed which is supported either by a crawler or at least four wheels mounted on two axles. The bed supports a boom which in turn carries the loading element. A common type of loading element is a bucket wheel which deposits the particulate matter on a conveyor running along the longitudinal axis of the boom. In many of the prior art material handlers, the boom is mounted on a turntable on the bed so that as the bed is advanced longitudinally into the pile, the boom may be slewed to increase the reach of the bucket wheel. The bed can be steered in a conventional manner, or instance, with the two wheels on one end of the vehicle rotated in synchronism about their turning axes, however, generally once positioned with respect to the pile, the bed moves linearly and lateral coverage is attained by slewing the boom.

The greatest limitation of the prior art bulk material handlers is that the turntables are constructed of massive components which add to the weight and cost of the apparatus. In addition, counterbalancing of the boom is required for satisfactory operation of the turntable. Often this is provided for by a second conveyor for transferring the particulate matter from the conveyor on the boom to other apparatus. However, since the counterbalancing conveyor slews with the boom, the other apparatus must accomodate for the arc circumscribed by the discharge end of this conveyor.

In a recent French design, a boom carrying a bucket-wheel loader is pivoted in overlapping relationship on an elongated body. The elongated body is supported at the end opposite the free end of the boom by two wheels mounted on a common axle. The other end of the elongated body is supported by a rotatable truck. When the wheels of the truck are aligned with the wheels on the common axle, the reclaimer can be driven linearly in the direction of the longitudinal axis of the reclaimer. With the truck turned 90°, the entire reclaimer may be slewed.

U.S. Pat. No. 3,391,776 discloses a combination scraper and loader supported by a steerable tail wheel and a pair of main wheels which remain in parallel planes while being steered independently of the tail wheel. The main wheels are disengaged from the steering mechanism and permitted to swing 180° about the turning axis to an inboard position where they are reconnected to the steering mechanism for movement over a highway where there are limitations on vehicle width.

SUMMARY OF THE INVENTION

In accordance with the invention, the elongated body of a bulk material handler is supported at one end by a rolling support, such as a rotatable truck, and at the other end by two independently steerable main wheels mounted on either side of the elongated body. Independent steering means for the rotatable truck increases the maneuverability of the vehicle. A boom is pivotally mounted on the elongated body for movement in a vertical plane parallel to the longitudinal axis of the elongated body. Preferably, the pivot point of the boom is vertically aligned with the vertical pivot of the rotatable truck. In the disclosed embodiment of the invention, a conveyor mounted on the boom receives load deposited thereon by a bucket loader rotatably attached near the free end of the boom.

The steering mechanism for the main wheels is capable of turning the main wheels in the same angular direction, which may be considered a first mode of operation, or in opposite angular directions, which may be considered a second mode of operation. Each main wheel is equipped with its own driving motor. With the main wheels aligned in parallel planes and with the steering mechanism in the first mode of operation, the reclaimer may be driven in a conventional manner in a straight or curved path generally aligned with the longitudinal axis of the elongated body. By operating the steering mechanism in the second mode of operation, the main wheels may be turned in opposite directions until their rolling axes intersect the vertical pivot of the rotatable truck. In this configuration, operation of the driving motors to drive the main wheels in the same angular direction causes the entire reclaimer to slew about the rotatable truck. If the main wheels are further rotated in opposite directions until their rolling axes are parallel to the boom and the rotatable truck is turned until its rolling axis is also parallel to the boom, the reclaimer may be driven in a path generally transverse to the boom, This configuration is useful in certain types of loading operations.

In a preferred embodiment of the invention, wheel supports pivotally mounted to either side of the eongated body support the main wheels on stub axles. Hydraulic rams connected to steering arms obliquely extending from the wheel supports effect the turning of the main wheels through angles in excess of 90°.

By providing means through which the bulk material handler may be driven in a line parallel to the boom and means through which the boom may be slewed without the need for a turntable, the weight and complexity of the reclaimer may be greatly reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

An understanding of the invention may be gained by reference to the description of the preferred embodiment of the invention and the attached drawings in which:

FIG. 1 is a perspective view of a reclaimer according to the invention;

FIG. 2 is a side elevation view of the reclaimer of FIG. 1 with the limits of travel of certain components shown in dash-dot lines;

FIG. 3 is a sectional end elevational view of the reclaimer taken along the lines III—III in FIG. 2 with some parts missing;

FIG. 4 is a plan view of the reclaimer configurated for one mode of operation and with the positions of certain components in an alternate mode of operation shown in dashed lines and with some parts missing;

FIG. 5 is a sectional view of the bucket wheel and bucket wheel drive taken along the line V—V in FIG. 2;

FIG. 6 is a plan view of the reclaimer in a first mode of operation; and

FIG. 7 is a plan view of the reclaimer in a second mode of operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Reference to FIGS. 1 through 4 reveal that the reclaimer comprises an elongated body identified by the general reference character 1 supported at one end by rolling support 3 and at the other end by main wheels 5 and 7. The rolling support 3 is illustrated as a truck carrying two wheels 9 and 11 mounted on a common axle 13 and rotatable about the vertical axis 15. It is to be appreciated that the rolling support may take other forms such as wheels mounted on a fixed axle or a crawler, however, it is preferred that the rolling support be rotatable about a vertical turning axis. It is also preferred that the rolling support be provided with a steering mechanism 16.

Wheel mounts 17 and 19 extending horizontally from either side of the opposite end of the elongate body 1, receive king pins 21 and 23 which pivotally mount the wheel supports 25 and 27 for the main wheels. The main wheels 5 and 7 are connected to the wheel supports 25 and 27 respectively by stub axles 29 and 31. Steering arms 33 and 35 extend rearwardly from wheel supports 25 and 27 respectively and are generally perpendicular to the associated stub axles. The cylinder 37c of double acting hydraulic ram 37 is pivotally connected to a boss 41 affixed to the side of the elongated body. The plunger 37p of the hydraulic ram is pivotally connected to the steering arm 33 through an appropriate pivotal connection. Similarly, double acting ram 39 is pivotally connected to boss 33 in the opposite side of the elongated body and to steering arm 35 associated with the main wheel 7. The operation of these hydraulic rams in effecting the turning of the main wheels will be discussed below.

The main wheels 5 and 7 are separately driven by individual drive units 45 and 47 mounted directly on the stationary drums at the center of each wheel as is conventional with heavy equipment. The drive units illustrated are hydraulicaly operated, however, electric drive units could also be utilized.

The elongated body 1 houses the equipment necessary to develop the hydraulic pressure, and in the case of electric drive motors, the electric power necessary, to operate the machine. This equipment is accessable through the doors 49 on either side of the elongated body.

A boom identified by the general reference character 51 is pivotally mounted on top of the elongated body 1 through shaft 53 and flanges 55 and 57. The boom is pivoted at the end of the elongated body adjacent the rotatable truck 3 and extends beyond the opposite end of the elongated body in overlapping relationship. The vertical angle assumed by the boom is controlled by hydraulic ram 59 pivotally connected to boss 61 on the underside of the boom and boss 63 extending along the center line of the lower front end of the elongated body.

A belt type conveyor 65 extends substantially the full length along the top of the boom. The conveyor is driven by a drive unit 67 connected to the conveyor adjacent the pivoted end of the boom. Again, this drive unit is illustrated as a hydraulic motor but could also be an electric drive.

As best seen by reference to FIGS. 2 and 5, a bucket wheel side loader identified by the general reference character 69 is rotatably mounted near the free end of the boom on shaft 71. The shaft 71 is journaled in roller bearing mounts 73 resting on the flanges 75 on either side of the boom 51. The shaft 71 is rotated by two drive units 77 and 79 disposed on either side of gear 81, which is fixedly attached to the shaft 71. As in the case of the other drives, the units 77 and 79 may be either hydraulic drives as illustrated or electric drives. The shaft 71 is also journaled through roller bearings 85 to the gear housing 83 upon which the drive units 77 and 79 are mounted.

The bucket wheel 69 is composed of an octagonal frame 84, the perimeter of which is offset in a direction towards the conveyor from its hub 86 mounted on the shaft 71. Mounted on each of the faces of the octagonal frame is a bucket 87 which communicates with an associated partitioned chamber in the frame 84. Baffles 89 are diagonally mounted in each of the octagonal chambers with the edge of the baffle away from the conveyor mounted closer to the buckets. In operation, the particulate matter is scooped up by the buckets near their lower most point of travel as viewed in FIG. 2 as the bucket wheel rotates in the counterclockwise direction. As the bucket wheel continues to rotate, the particulate matter slides down the bucket until it falls into the associated chamber where it is deflected by the baffle 89 against a retainer 91. The retainer 91 however does not block the entire side of the chamber and as the particular bucket reaches its highest point of travel, the particulate matter is deposited on the conveyor 65 without spillage. Perhaps a better understanding of the arrangement can be appreciated from the perspective view of FIG. 1.

As can be seen from FIG. 2, the boom may be raised by hydraulic ram 59 to an angle of approximately 18° above the horizontal. It can also be seen that with the upper surface of elongated body 1 sloping from the pivot point of the boom toward the front of the reclaimer, the boom may assume a negative angle with respect to the horizontal, which permits the bucket wheel to excavate to a point below the level upon which the wheels of the reclaimer are resting. Such vertical coverage, which was not obtainable on prior art reclaimers not utilizing a turntable, permits blending of the articulate matter removed from the pile.

Toward the front end of the elongated body, a frame 95 having two vertical legs and a cross bar stradles the boom. Mounted well up on one of the legs of this frame is an operator's cab 97 which houses the controls for the reclaimer. A series of rods 99 horizontally affixed to the side of the elongated body and the leg of the

frame 95 form a ladder providing access to the operator's cab. Railings 100 along either side of the upper surface of the elongated body provide protection for workers servicing the conveyor.

The controls provided for the operator permit control of the driving motors on the main wheels, the turning of the main wheels, the turning of the truck, the raising and lowering of the boom, the operation of the conveyor and the operation of the bucket wheel loader. With the main wheels 5 and 7 of the reclaimer positioned as shown in FIG. 2, and as shown in dashed lines in FIG. 4, with their rolling axes perpendicular to the boom and therefore the longitudinal axis of the elongated body, the vehicle may be operated as any conventional vehicle with three points of support. That is, the vehicle may be driven forward toward the bucket wheel loader by applying power to the motor 45 to drive the main wheel 5 in a clockwise direction as viewed from the side of the reclaimer shown in FIG. 2 and by operating the motor 47 to drive the main wheel 7 in a counterclockwise direction as viewed from the other side of the relcaimer. The reclaimer may be backed up of course by operating each of these motors in the opposite directions. The reclaimer may be steered in this mode of operation by turning the rotatable truck 3 and/or simultaneously turning the main wheels 5 and 7 so that they remain in parallel planes. The main wheels 5 and 7 may be maintained in parallel planes by operating the double acting hydraulic rams 37 and 39 an equal amount in opposite directions. That is, if the vehicle were to make a left turn while traveling forward, the ram 37 would be extended to turn the wheel 5 left while the ram 39 was retracted an equal amount to turn the wheel 7 to the left. Turning of the rotatable truck in the direction opposite to the direction in which the main wheels are turned, enables the vehicle to turn very sharply. Turning the rotatable truck an equal amount in the same direction as the main wheels enables the vehicle to move obliquely to the boom.

Once the reclaimer has been positiond relative to the stock pile to be worked on, the main wheels 5 and 7 may be swiveled about their respective king pins in opposite directions until they are in the position shown in FIG. 4 in which their rolling axes 6 and 8 intersect at a point on the turning axes of the rotatable truck. In this position, the entire reclaimer may be slewed about the turning axis of the rotatable truck by driving each of the main wheels in the same angular direction as viewed by one facing the wheels. For instance, if the reclaimer is to be slewed in the counterclockwise direction as viewed in FIG. 4, each of the main wheels would be driven in a clockwise direction. It should be remembered that when the reclaimer was being operated in the conventional manner, one of the main wheels turned in a clockwise direction, while the other one turned in a counterclockwise direction. During this slewing operation, the steering mechanism for the rotatable truck 3 is disengaged so that the elongated body may pivot freely about the turning axis of a rotatable truck. In repositioning the main wheels from the conventional position shown in FIG. 2 to the slewing position shown in FIG. 4, both hydraulic rams 37 and 39 are extended thereby turning wheel 5 in a counterclockwise direction and wheel 7 in a clockwise direction about their respective turning axes.

FIGS. 6 and 7 illustrate two modes of operation of the reclaimer. As shown in FIG. 6, the reclaimer is configured for operating on the end face 101f of elongated pile 101 by slewing in the manner previously described. Considering that the center of the bucket whel is 50ft. from the pivot of the boom, the reclaimer can work on a pile 100ft. wide by slewing through an arc of 180°.

FIG. 6 also illustrates how the reclaimer may be used with other equipment. Specifically, a stacker-reclaimer comprising a tower 103 rotatably mounted on a turntable 105 which moves on rails 107 parallel to the axes of the pile is shown. A conveyor 109 carried by the tower 103 receives the particulate matter from the reclaimer conveyor 65 and deposits it on a tripper conveyor 111 running parallel to the pile. It should be appreciated that since the discharge end of the reclaimer conveyor is located over the slewing axes of the reclaimer, the stacker-reclaimer does not have to be repositioned as the reclaimer slews.

The perspective view of FIG. 1 also illustrates the reclaimer in this mode of operation. Notice that a funnel 110 insures that the particulate matter is deposited on the conveyor 109. If desired, an auxiliary conveyor 65a shown in FIG. 2 may be cantilevered from the reclaimer under the main conveyor 65. This conveyor is not necessary for counterbalancing as in the turntable type of prior art reclaimers. Any counterbalancing necessary can be provided for by the concentration of mass in the area of the rotatable truck.

FIG. 7 illustrates a mode of operation of the reclaimer in which the rolling axes of the two main wheels and the rotatable truck are turned until they are parallel to the boom. In this configuration, the reclaimer may be driven in a direction transverse to the boom and may be utilized as shown in FIG. 7 to cut a path parallel to the longitudinal axis of an elongated pile 101. As shown in FIG. 7, a truck may be driven in synchronism with the reclaimer to receive the particulate matter from the discharge end of the conveyor.

It is evident that the disclosed reclaimer is extremely versatile and may be used in many modes of operation. It should also be understood that the reclaimer may be utilized in conjunction with other types of stock pile handling equipment and that those depicted are only illustrative.

I claim:

1. A bulk material handler comprising:
   a. an elongated body;
   b. a boom pivotally mounted near one end of said elongated body for vertical movement in a plane parallel to the longitudinal axis of said elongated body and with the boom extending beyond the opposite end of the elongated body;
   c. a conveyor extending for a substantial length along the axis of said boom;
   d. a pivotally mounted wheel assembly rotatable about a vertical turning axis passing through the longitudinal axis of the elongated body for supporting said one end of said elongated body;
   e. a pair of main wheels straddling and vertically overlapping the opposite end of the elongated body for supporting said opposite end thereof, said main wheels each being rotatable about a vertical turning axis in excess of 90°;
   f. independent drive means for each of said main wheels;

g. main wheel steering means for turning said main wheels in the same angular direction about their vertical turning axes and in opposite angular directions about their turning axes in excess of 90°; and

h. independent steering means for turning said pivotally mounted wheel assembly about the vertical turning axis.

2. The bulk material handler of claim **1** including:

a. main wheel mounts extending outward generally horizontally from either side of said opposite end of said elongated body, with at least the outer portion of each of said main wheel mounts extending obliquely away from said one end of the elongated body and with the longitudinal axis of each outer portion intersecting the associated main wheel; and

b. main wheel support members pivotally mounted near the end of the main wheel mounts for rotation in a horizontal plane, said main wheel support members including stub axles extending outwardly upon which said main wheels are rotatably affixed and said steering arms extending horizontally from aid main wheel support members and connected to said main wheel steering means.

3. The bulk material handler of claim **2** wherein said main wheel steering means includes means for turning said main wheels in opposite angular directions about their vertical turning axes between a first home position in which the rolling axes of both of said main wheels are perpendicular to the longitudinal axis of aid elongated body and a second home position in which the rolling axes of both of said main wheels are parallel to the longitudinal axis of said main wheels, and means for rotating said main wheels about their vertical turning axes an equal amount in the same direction from each of said home positions.

4. The bulk material handler of claim **3** wherein said independent steering means includes means for turning the rotatably mounted wheel assembly about the vertical axis the same amount and in the same direction as the main wheels from each of the main wheel home positions.

5. The bulk material handler of claim **1** wherein said main wheel teering means include means for turning said main wheels in opposite directions about their vertical turning axes between a position in which the rolling axes are parallel and a position in which the rolling axes of both of said main wheels simultaneously intersect the vertical turning axis of said pivotally mounted wheel assembly.

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