July 12, 1955 C. G. KUEHN, JR 2,712,876

SELF-LOADING AND DUMPING VEHICLE

Filed March 31, 1952

Fig. 1

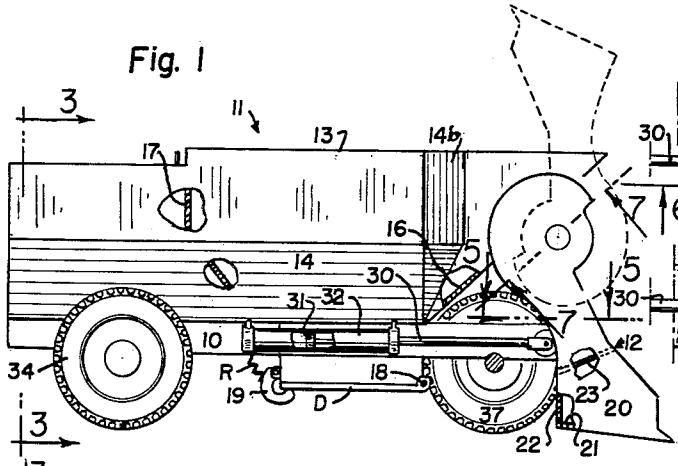
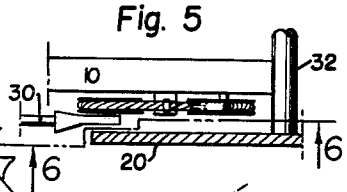


Fig. 5



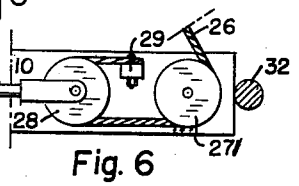


Fig. 6

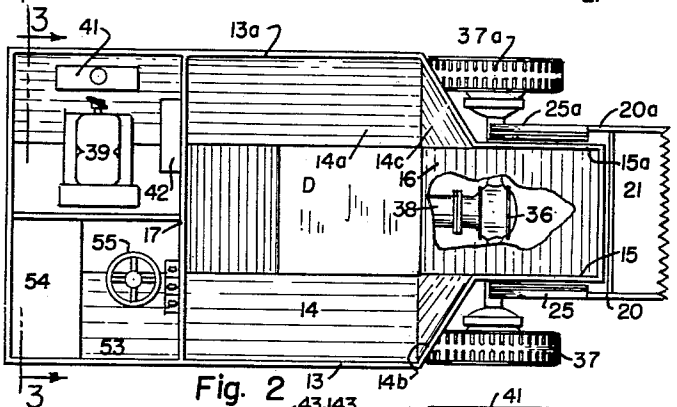


Fig. 2

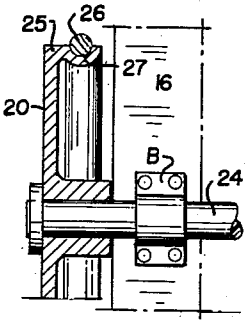


Fig. 7

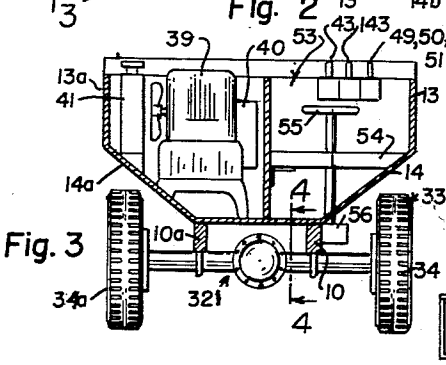


Fig. 3

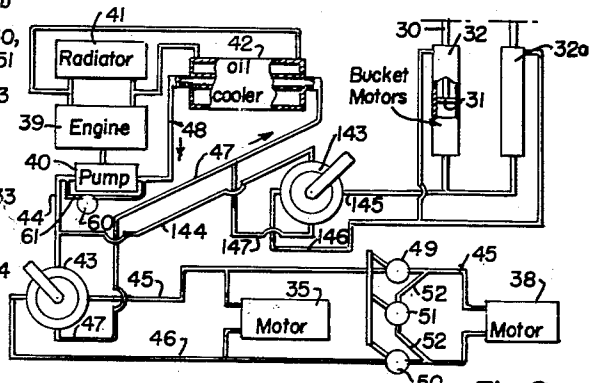


Fig. 8

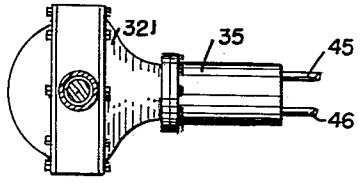


Fig. 4

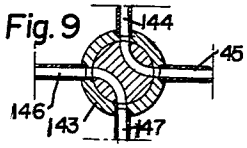


Fig. 9

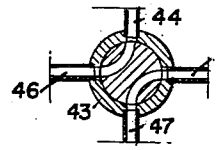


Fig. 9a

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SELF-LOADING AND DUMPING VEHICLE

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6 Claims. (Cl. 214—78)

This invention relates to improvements in machines for loading, transporting, and dumping materials, such as ore, dirt, and the like.

One of the objects of the invention is to provide a machine of the foregoing type which eliminates gear transmissions, clutches, and other power transmission means formerly employed to transmit power from the driving motor or engine to the wheels.

Another object is to provide hydraulic oil operated motors for driving the traction wheels of the machine, which motors are supplied by a high-pressure pump driven by a prime mover, such as an internal combustion engine or electric motor.

Another object is to provide controls for selectively driving all traction wheels of the machine, or only a part thereof.

Another object is to increase the speed of the machine when only a portion of the traction wheels are driven, with the engine and pump speed remaining substantially constant.

A further object is to provide novel hydraulic lift means for a loading scoop or bucket.

Still further objects, advantages, and salient features will become more apparent from the description to follow, the appended claims, and the accompanying drawing, in which:

Figure 1 is a side elevation of the machine, portions being broken away;

Figure 2 is a top plan of Figure 1, portions being broken away;

Figure 3 is a section taken on line 3—3, Figures 1 and 2;

Figure 4 is an enlarged section taken on line 4—4, Figure 3;

Figure 5 is an enlarged section taken on line 5—5, Figure 1;

Figure 6 is a section taken on line 6—6, Figure 5;

Figure 7 is an enlarged section taken on line 7—7, Figure 1;

Figure 8 diagrammatically illustrates the hydraulic system and its controls; and

Figures 9 and 9*a* illustrate two positions of a valve employed in Figure 8.

Referring in detail to the drawing, the machine comprises, in general, a suitable wheel supported frame including side members **10**, **10***a*, which carry a body **11**, having an elevating scoop or bucket **12** at the end opposite from the engine.

The body comprises side panels **13**, **13***a*, the lower portions **14**, **14***a* of which slope downwardly and inwardly, as best shown in Figure 3. The side panels also have inwardly slanting portions **14***b*, **14***c* which join a pair of parallel vertical panel portions **15**, **15***a*, the latter being connected at their lower edges to a downwardly and rearwardly sloping floor **16**. A vertical panel **17** extends between panels **13**, **13***a*. The panels so far described form a loading bin or hopper for receiving the material to be transported and dumped. The bottom of the bin is provided with a door D, hinged on transverse hinge pin **18**, and retained closed by a latch **19** which may be moved to unlatched position by the machine operator in any manner well undertood in the art, such as by a release rope R connected to the latch.

The scoop comprises a pair of side plates **20**, **20***a* between which extend, adjacent the lower end, a plate **21** forming a bottom wall for the bucket proper, a plate **22** forming a rear wall, and a plate **23** forming a top wall.

Plates **20**, **20***a* are journaled on the ends of a transverse shaft **24**, affixed to a floor **16** in any suitable manner, such as by clamp brackets, one of which is shown at B. The upper edges of plates **20**, **20***a* are provided with curved flanges, one of which is shown at **25**, Figure 7, which receives a cable **26** in a groove **27** in the flange. The upper end of the cable is secured at the upper end of the groove and thence extends downwardly around the flange, around an idler pulley **27***1*, rotatably supported by frame **10**, around pulley **28** to a bracket **29**, affixed to the frame, where the lower end of the cable is affixed. Pulley **28** is rotatably carried by an end of piston rod **30** actuated by a piston **31**, disposed in actuator cylinder **32**, affixed to the frame. A similar actuating mechanism is employed on the opposite side of the machine. It will be apparent that when the pistons in the cylinders move to the left (Figures 1, 5 and 6), the pulleys carried by the front ends of their piston rods will draw the cables around the idler pulleys and lift the scoop to the dotted position, Figure 1, where it will discharge its contents into the bin. As will be apparent, an increment of rectilinear bodily movement of pulley **28** effects twice said increment of movement to the upper end of the cable.

Flanges **25**, **25***a* each extend approximately 180 degrees around the axis of shaft **24**. Approximately 90 degrees of the lower portion of each flange is circular and concentric with the axis of shaft **24** and the remainder is formed as an involute with the top end closer to the axis of rotation than the circular portion. With piston **31** moving at substantially constant rectilinear velocity, it will be apparent that the scoop swings at substantially constant angular velocity for approximately the first 90 degrees of its upperward swing and thereafter accelerates in angular velocity through approximately the last 90 degrees of its upward swing.

It will be apparent that the cable construction, just described, is exemplary of any type of flexible member, such as a chain, or the like.

To limit rearward motion when the scoop is in its lower position, a bar **32** is provided which extends between plates **20**, **20***a* which abuts the forward ends of frames **10**, **10***a*. The scoop may be suitably counterweighted, or spring urged, toward the lowered position; when it is raised to its upper position, as shown in dotted lines, Figure 1, so that it will return to the lowered position when the actuator pistons are moved to the right.

The machine is supported at the engine end by a differential housing **321** with differential mechanism therein, wheels provided with pneumatic tires **34**, **34***a*, being connected to the outer ends of the axle shafts contained within the housing. Since devices of this kind are commonly used in automobiles and trucks, detailed description is omitted to simplify the disclosure. As shown in Figure 4, the central portion of the differential housing is provided with an enlarged portion which contains the conventional ring gear and its driving pinion, and the differential gears (not shown). To pinion end of this portion of the housing, a reversible hydraulic motor **35** is affixed, its driving shaft being coupled to the pinion in any desirable manner.

The dipper end of the machine is supported by a similar differential device **36** and wheels with tires **37**, **37***a*,

this being essentially the same as the differential assembly previously described with the exception that the wheels may be rotated about substantially vertical axes so that the machine may be steered. This dipper-end housing may be of any conventional construction such as used on "Jeeps" or other front wheel-drive vehicles. A reversible motor **38**, like motor **35**, is similarly connected to the driving pinion of the dipper-end differential.

While the steering wheels above mentioned have been illustrated as being located at the dipper end of the machine for the purpose of simplifying the disclosure, it will be understood that for mechanical reasons the preferred position for said steering wheels may be at the engine end of the machine.

A prime mover **39** is disposed within the body, this being coupled to a liquid pump **40** which operates motors **35** and **38**, and actuators **32** and **32***a*. A coolant radiator **41** is also provided to cool the engine and supply coolant to a heat exchanger **42** for cooling the oil employed to operate the various instrumentalities.

Motors **35**, **38**, previously referred to, are of the type which produce substantially constant torque at constant oil supply pressure.

Their speed and horse power are substantially directly proportional to the volume of oil delivered thereto. These characteristics apply to either direction of rotation. Motors of this type are well known, one manufacturer thereof being the Sundstrand Machine Tool Co. of Rockford, Illinois.

The pump is of the vane type which delivers substantially constant volume at a given speed and pressure. At a given speed the volume may also be varied by inversely varying the pressure, that is, to give constant horse-power output. The driving torque of the pump is substantially proportional to pressure. A manual control on the pump provides constant output pressure which may be varied at will. Pumps of this type, are also conventional. Other types of oil pumps may be substituted for the vane pump described.

Referring to Figures 8, 9 and 9*a*, it will be assumed that it is desired to move the machine into the material to be collected by the scoop. With valve **43** in the position shown in Figure 9, pump **40** will deliver oil through conduit **44**, through the valve to conduit **45**, thence through motor **35**, through conduit **46**, through the valve to conduit **47**, through oil cooler **42** and back to the pump through conduit **48**. Motor **38** is also connected to conduits **45** and **46**, that is, the two motors are in parallel, hence, the oil delivered to conduit **45** will be divided between the two motors with each applying torque to the set of wheels it drives.

Assuming now, that it is desired to move the machine in a reverse direction, valve **43** is moved to the position shown in Figure 9*a*. Oil is then delivered through conduit **44**, valve **43** to conduit **46**, through motor **35** to conduit **45**, through valve **43** to conduit **47**, and thence back to the pump through the oil cooler **42** and conduit **48**. Since the oil is now flowing through motor **35** in the reverse direction, the motor rotates in the reverse direction and moves the machine in a reverse direction. It is apparent, also, that the oil will be similarly divided between motors **35** and **38**, as previously described, and both motors will operate in the reverse direction.

While the reverse feature just described may optionally be employed, it will sometimes be preferred to operate only one of the motors in reverse direction, for example, motor **35**. To attain this end, a valve **49** in conduit **45** is closed, a valve **50** in conduit **46** is closed, and a valve **51** in a bypass conduit **52**, downstream from valves **49**, **50** is opened. This shuts off the supply and return of oil to and from motor **38**, and as it rotates from power supplied by wheels **37**, **37***a*, the oil merely circulates through the motor and bypass conduit. Under these conditions the oil from conduit **44** is all delivered to motor **35**. If it be assumed that motor

35 is the same size as motor **38**, the former will now receive twice the volume of oil. This, of course, due to the characteristics of the motor, previously described, will operate motor **35** at twice its former speed and, hence, move the machine at twice the former speed. Since the load on the machine and the traction required by the wheels is maximum when the scoop is moving into the material and will normally be a minimum when the machine is being moved to or from the unloading station, it becomes apparent the utilization of this increased speed under minimum load conditions effects considerable saving of time in the overall operations of loading, transporting, dumping and return to the loading station.

A valve **143**, similar to valve **43**, is employed for controlling operation of actuators **32**, **32***a*. Assuming that this valve is in a position similar to Figure 9, oil will flow from conduit **44** to conduit **144**, through the valve to conduit **145**, moving the pistons in actuators **32**, **32***a* upwardly (Figure 8). Oil trapped in the upper ends of the actuators flows through conduit **146**, through the valve to conduit **147** and thence to the pump through conduit **47**, oil cooler **42** and conduit **48**, when the valve is moved to a position similar to Figure 9*a*, oil will flow from conduit **144**, through the valve to conduit **146** and thence to the upper ends of actuators **32**, **32***a* and force the pistons downwardly. Oil trapped in the lower ends of the actuators flows through conduit **145**, through the valve to conduit **147** and thence to the pump through conduit **47**, oil cooler **42** and conduit **48**.

It will be understood that when either of valves **43** or **143** are intermediate the positions shown in Figures 9 and 9*a*, no flow of oil will occur. In the case of the wheel drive, the wheels will be locked and in the case of the scoop, it, also, will be locked in the position it happens to be when valve **143** is moved to such intermediate position. It is apparent, therefore, that the control valves and motors provide braking means for the movement of the machine or the movement of the scoop.

The valves just described are disposed in a convenient location in the operator's compartment **53**, as shown in Figures 2 and 3, this compartment being provided with a seat **54** and a steering device **55** for guiding the machine. The steering device includes a reduction gear box **56** at its lower end which may be operatively linked to the steering wheels for controlling same. Since steering pitman arms, drag links, tie rods and other linkage employed for this purpose are well known in the art of steering of vehicles, the details have been omitted to simplify the disclosure.

The pump **40** may be provided with any suitable type of bypass valve **60** and bypass conduit **61** for permitting circulation between its inlet and discharge, as is well understood in the art.

When the machine is employed in a well-ventilated atmosphere, such as above the surface of the ground, any type of prime mover may be used, including a gasoline engine. When used in a mine, however, either a diesel engine or an electric motor is preferred. Electric motors, of course, produce no fumes, and it is now possible to condition the exhaust gas from diesel engines so that the mine atmosphere is not contaminated with objectionable gases. When an electric motor is employed, it may be connected to a trolley source of power, or by retractible cable reels with wires extending between the unloading station and the loading station, reels of this type being well known.

While the motors **35** and **38** are disclosed as directly connected to the differential pinions, it will be understood that suitable gearing, or other power transmission means, may be interposed between the motors and pinions so employed to furnish a desired speed of the machine.

While I have referred to the differential as containing a "ring gear" and "pinion," it will be apparent that

where higher reduction ratios are desired, the ring gear may be in the form of a worm wheel and the pinion in the form of a worm. The language "ring gear" and "pinion," as subsequently employed in the claims, is, therefore, intended to be generic to either type of gearing just referred to.

While I have described one manner of effecting speed control by cutting one of the motors out of the circuit, allowing the other motor a greater volume of liquid, it will be apparent that the speed of the machine, with either one or both motors driving same, may be varied by varying the pump pressure, and/or varying the pump speed by varying the speed of its prime mover.

Many modifications within the purview of the invention will become apparent to those skilled in the art and, hence, the specific disclosure is to be regarded as exemplary only, and the invention not limited thereto except as required by the state of the prior art and the scope of the appended claims.

Having described the invention, what is claimed as new is:

1. A material handling device having a scoop-end, comprising; a bin having an inclined portion projecting over the scoop-end of the device, scoop means pivotally carried by and on a fixed axis adjacent the scoop end of the device for movement between a lowered position wherein it may load material and a raised position gravitationally directly over the lowered position wherein it may unload the material into the bin, two pairs of wheels supporting the bin, each pair of wheels including differential gearing means for driving same, and one pair of wheels being steerable, first rotatable reversible hydraulic motor means operatively connected to the differential gearing for one pair of wheels, second rotatable reversible hydraulic motor means operatively connected to the differential gearing for the other pair of wheels, a liquid pump carried by the device for circulating liquid under pressure through the first and second motor means and back to the pump, means carried by the device for operating the pump, and control means carried by the device for supplying the first and second motor means with liquid for flow therethrough in either of opposite directions, whereby the first and second motor means may be reversed and the wheels rotated in either of opposite directions of rotation.

2. A device in accordance with claim 1 including control means for discontinuing circulation of fluid from the pump through the motor means for one pair of wheels, and for establishing a liquid by-pass circuit to permit same to idly rotate from power received from the pair of wheels same is operatively connected to, the discontinued circulation being supplied to the motor means for the other pair of wheels, whereby the latter receives a greater quantity of liquid and rotates at a higher speed.

3. A material handling device in accordance with claim 1 including hydraulic actuator means operated by said pump for raising the scoop to the raised position.

4. A material handling device in accordance with claim 3 wherein the scoop means includes spaced members mounting same for rotation about a substantially horizontal axis fixed near their upper ends and with respect to the bin, at least one of said members having curved means for receiving a flexible member thereabout, one end of said flexible member being affixed to the upper end of the curved means and the other end affixed relative to the bin, a rotatable member moveable relative to the bin by the actuator means, said flexible member being trained about said rotatable member in a manner such that an increment of bodily movement of the rotatable member effects a multiplication of said movement to the first-named end of the flexible member.

5. A device in accordance with claim 4 wherein said curved means is constructed and arranged to accelerate the angular movement of the scoop as it moves during the last portion of its movement from the lower to the upper position while said rotatable member bodily moves at substantially constant velocity.

6. A device in accordance with claim 4 wherein said curved means comprises a portion circular and concentric with said axis and another portion non-concentric with said axis.

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