United States Patent [19]

Fenske

[11] **3,812,607**

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[54] **LATERALLY AND VERTICALLY SHIFTABLE AUGER LOADERS**

[76] Inventor: **Howard D. Fenske,** 2646 Kenowa, S.W., Grand Rapids, Mich. 49504

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[52] **U.S. Cl.** **37/4,** 214/83.32, 198/213

[51] **Int. Cl.** **B60p 1/36**

[58] **Field of Search** ..... 37/4, 8, 9, DIG. 18, DIG. 5, 37/DIG. 15, 124, 126; 198/213–217; 214/83.32

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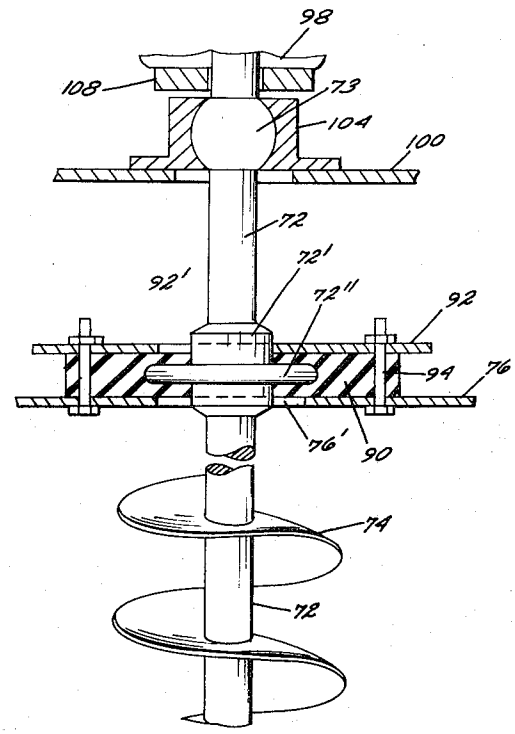
Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Eugene H. Eickholt
Attorney, Agent, or Firm—Price, Heneveld, Huizenga & Cooper

[57] **ABSTRACT**

A bowl type earth moving vehicle auger apparatus employing vertical augers above the earth inlet opening and scraper, the augers having free lower ends and having the upper ends specially mounted in a floating fashion to accommodate entry of large objects such as rocks. The auger lower end is laterally controllably shiftable in response to lateral stresses as a result of a special bearing assembly on the auger upper end shaft, and the auger is vertically shiftable in response to vertical stress as a result of the mounting arrangement of the auger framework to the bowl assembly. Also, the auger is vertically shiftable in cooperation with opening of the apron, as a result of the auger framework being specially cooperable with the apron elevating mechanism, to assure free discharge flow from the bowl without auger interference.

18 Claims, 9 Drawing Figures



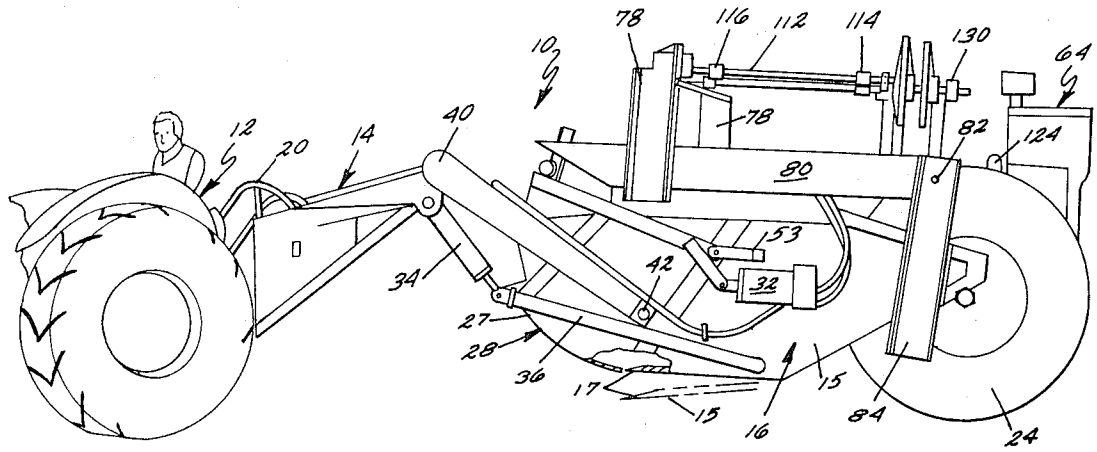

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FIG. 1.

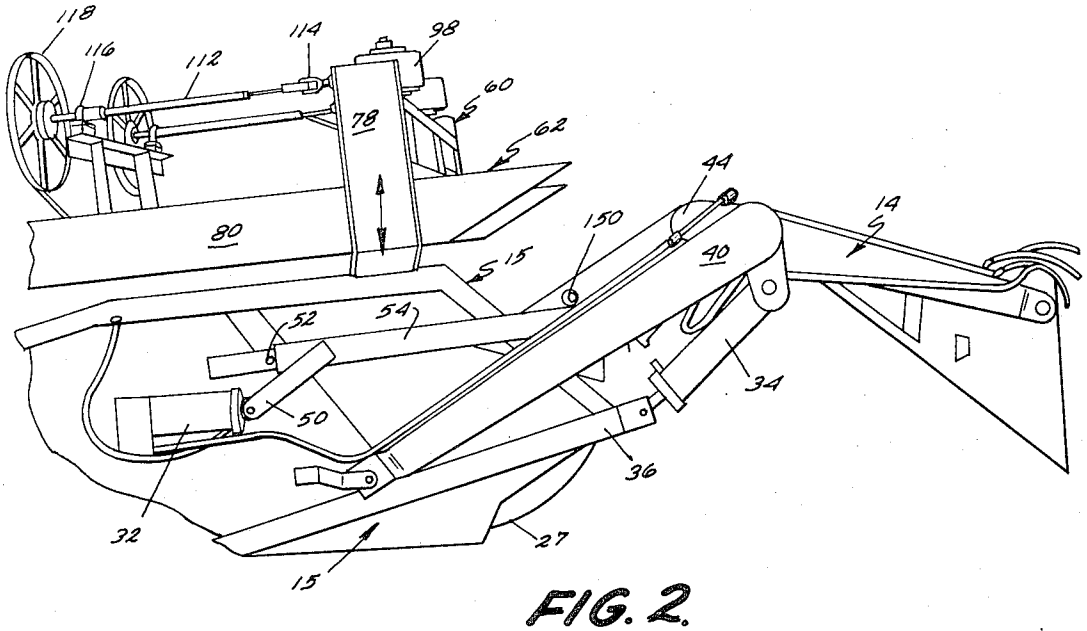
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FIG. 2.

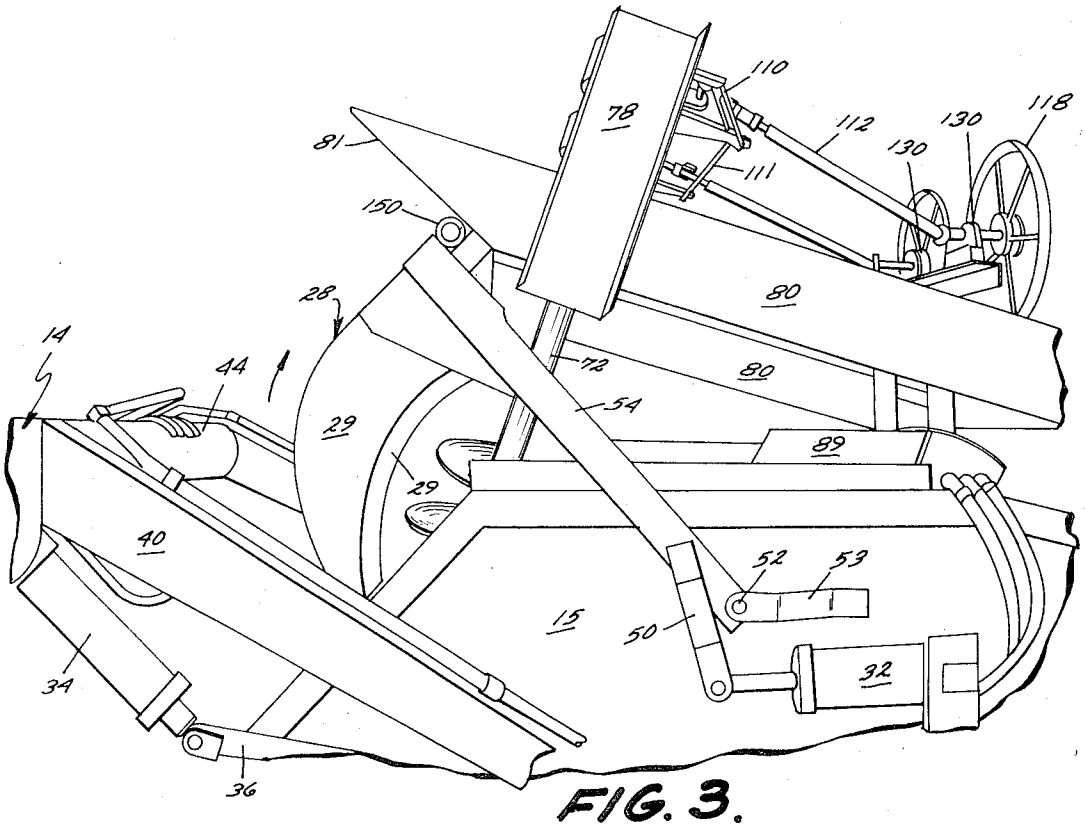
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FIG. 3.

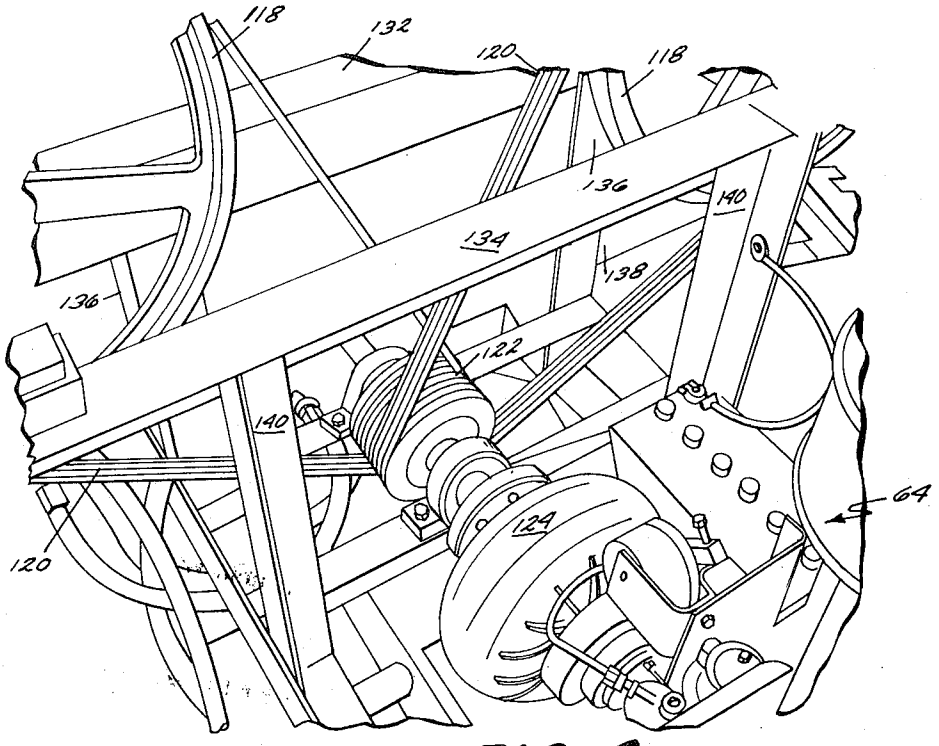
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FIG. 4.

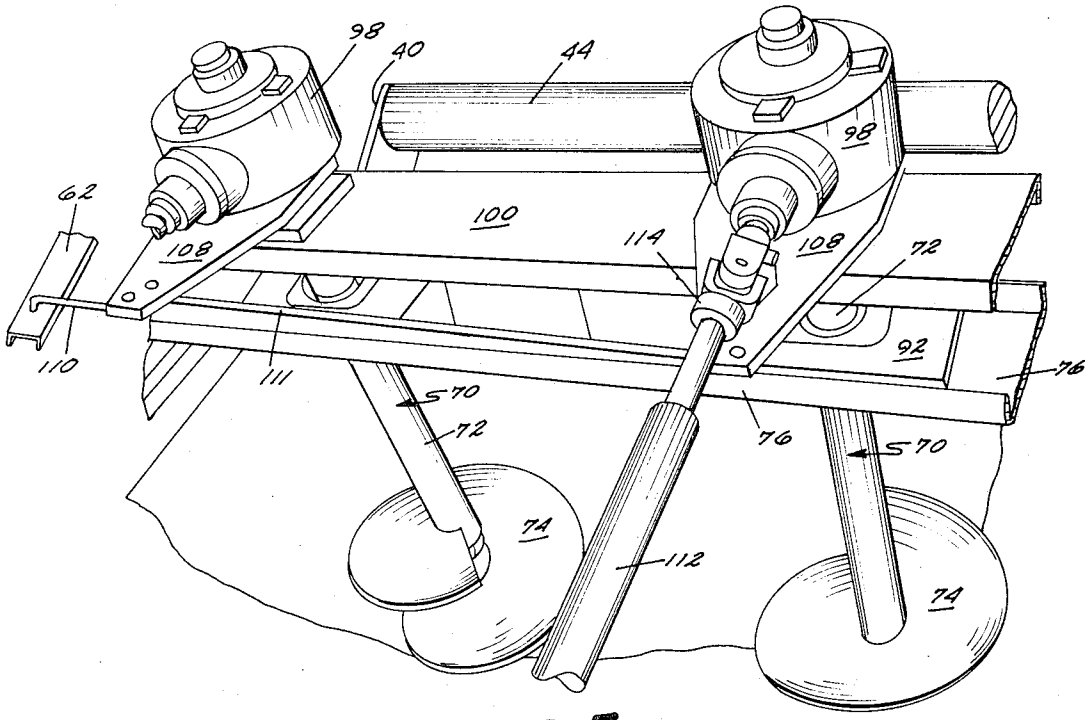
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FIG. 5.

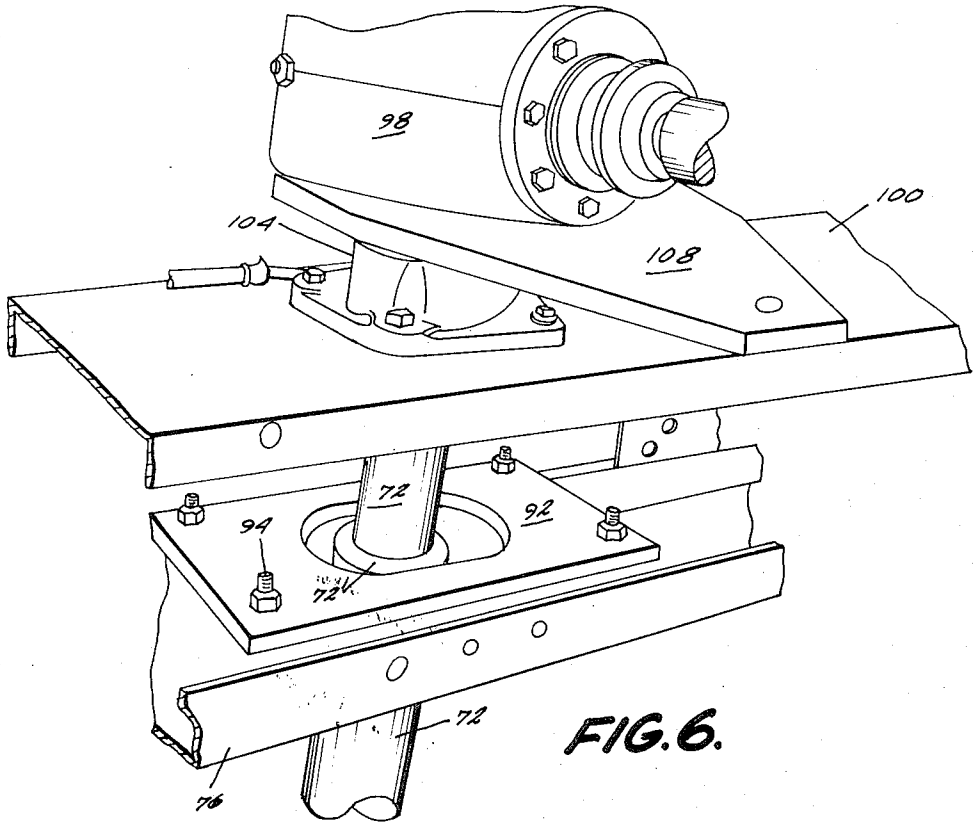
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FIG. 6.

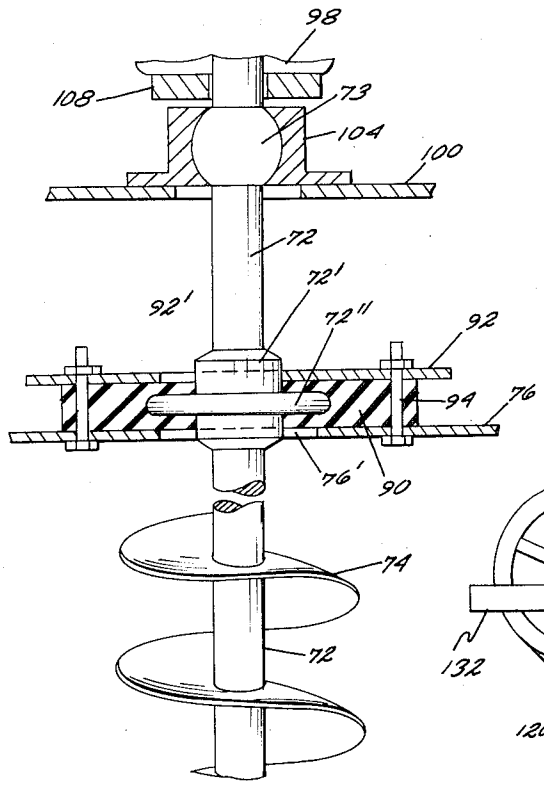

FIG. 7.

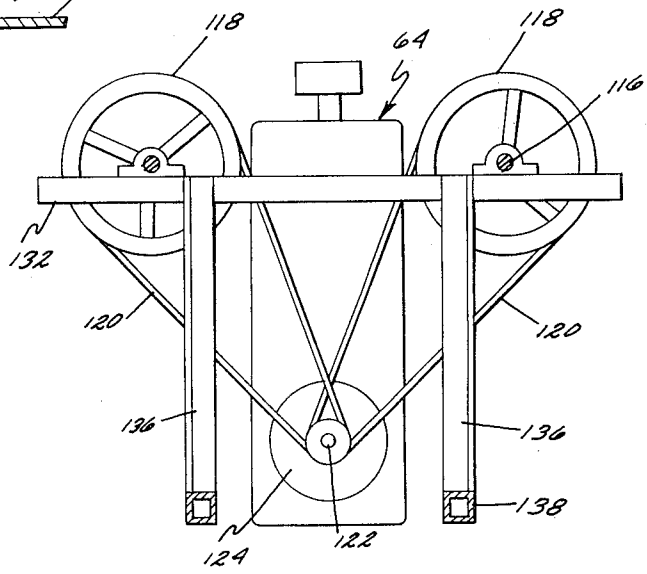

FIG. 9.

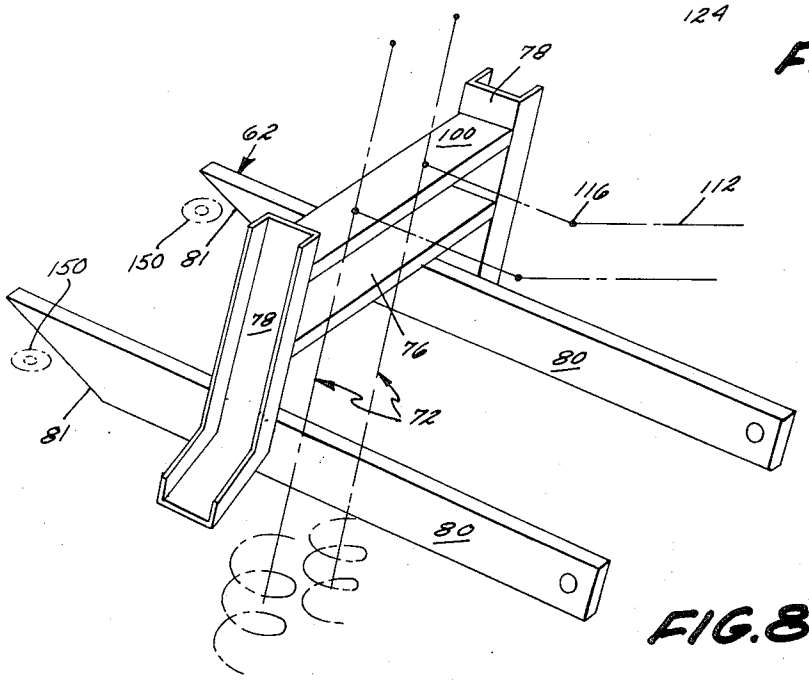

FIG. 8.

LATERALLY AND VERTICALLY SHIFTABLE AUGER LOADERS

BACKGROUND OF THE DISCLOSURE

This invention relates to earth moving vehicles, and more particularly to a bowl type earth moving vehicle employing a loading auger assembly.

This invention constitutes an improvement of the basic apparatus in my U.S. Pat. No. 3,533,173 entitled Earth Mover With Powered Auger Combination, issued Oct. 13, 1970.

The apparatus in my above identified patent proved to be effective in the manner there set forth. The unit is capable of self loading and is efficient. Further, debris and smaller rocks can be accommodated comparable to conventional assist-filled earth movers.

Periodically, however, operating conditions were experienced wherein breakage and/or damage of the auger assembly occurred. It was discovered that this usually occurred wherein an obstacle of substantial size, particularly a large rock, was encountered. It was therefore desirable to be able to accommodate terrain containing such large obstacles, whether known or not, without concern over damage to the auger assembly. Yet the unit had to be fully effective and efficient under regular operating conditions.

SUMMARY OF THE INVENTION

An object of this invention is to provide an earth moving vehicle and auger assembly capable of accommodating various types of operating conditions, including large rocks, frozen earth clumps, and large chunks of debris, and capable of continued rapid efficient loading and unloading, without assistance, whether in abrasive sand, stiff clay, rocky ground, or ground containing a heavy frost layer. The invention provides an auger assembly which has a controlled floating arrangement relative to the earth mover. The auger assembly can readily be attached to new or used earth movers, and can be quickly removed if desired. The assembly is capable of substantial abuse without damage or breakdown.

The novel auger assembly is attachable by simple pivot connections to the earth mover bowl, is elevated during bowl discharge to prevent interference during discharge, with elevation of the bowl apron and by the arms of the bowl apron, yet without being mounted on the apron or its arms.

The auger assembly is capable of shifting vertically under vertical stress as by an entering rock to temporarily move out of the rock path, while still operating, and of returning to its fully lowered condition after passage of the rock or other obstacle.

The lower free ends of the individual augers are capable of temporary lateral shift in response to lateral stress as by an entering rock or the like, while still operating, and returning to the original position. The vertical and lateral shifting can occur simultaneously if necessary, to provide excellent flexibility to the system.

These and many other objects and features, as well as structural details will be readily apparent upon studying the following detailed description in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of an earth mover employing the invention;

FIG. 2 is a fragmentary perspective view of the opposite side toward the front end portion, of the earth mover in FIG. 1, without the tractor;

FIG. 3 is a fragmentary enlarged perspective view of the main body portion of the earth mover, showing the front apron elevated and the auger assembly elevated;

FIG. 4 is an enlarged fragmentary perspective view looking down upon the power drive train for the auger asssembly of the apparatus;

FIG. 5 is a fragmentary perspective view of the auger elements, a portion of the drive mechanism thereto, and the floating bearing arrangement supporting them;

FIG. 6 is a fragmentary perspective and further enlarged view of one of the auger bearing mounting arrangements;

FIG. 7 is a fragmentary elevational sectional view of the bearing arrangement for an auger of the invention;

FIG. 8 is a perspective view of the frame assembly for the augers of the invention; and

FIG. 9 is an elevational view of one type of power drive means for the augers, as viewed in a rearward direction from the bowl unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring specifically to FIG. 1, the apparatus there depicted comprises an articulated earth moving vehicle **10** employing a powered towing tractor **12** interconnected through an articulated hitch **14** with the bowl type earth moving assembly **16.**

Tractor **12** constitutes a conventional two wheel or four wheel tractor as desired, employing any suitable type of engine, and conventional drive wheels **18.** Hitch **14** is of conventional type, e.g., employing a forward vertical pivot axis for controlled articulation between vehicles **16** and **12.**

The tractor may also operate suitable electrical generating equipment and/or hydraulic pumping equipment, the latter being useful for operating fluid cylinders on the bowl assembly in a manner to be described more specifically hereinafter. Alternatively a supplemental engine on the bowl assembly may be employed for producing electrical and/or hydraulic or pneumatic power as needed. The hydraulic connections can be made through suitable hoses **20** between the towing vehicle and the towed vehicle if the tractor engine is employed for hydraulic power as in the form depicted.

The towed bowl assembly may assume a variety of somewhat different physical forms of the type presently marketed. Basically, this type of unit employs, between the hitch subassembly **14** on the front end and wheels and axle subassembly **24** on the rear end, a large bowl **26** which preferably and normally has an openable-closeable apron subassembly **28** on the front portion thereof behind the hitch. When this apron assembly is elevated, the front end of the bowl is opened controlled amounts, as is known. During filling of the bowl, the apron is usually only partially opened to allow dirt entry without spillage back out. During emptying i.e., discharge of the contents from the bowl, the apron is

fully elevated to fully open the front end of the bowl.

Also, when the bowl is to be filled, first the apron is partially elevated as noted, and then the bowl front end is lowered to cause a scraper blade **17** of conventional type immediately at the rear edge of the opening to be lowered into engagement with the earth. These functions will be more specifically described hereinafter.

A pair of fluid cylinders **32** mounted on opposite sides of the bowl **15** function to elevate the apron controlled amounts. A pair of fluid cylinders **34** mounted forwardly of the apron serve to lower the entire front end of the bowl for engaging the scraper **17** with the earth, as depicted in phantom lines in FIG. **1**, or elevating the entire front end of the bowl to hoist the scraper blade out of engagement with the earth. Cylinders **34** each have one end pivotally attached to the hitch subassembly **14**, with the piston rods thereof being pivotally attached to the forward end of a pair of arms **36** fixedly attached to the opposite exterior sides of the bowl **15**. Extension of cylinders **34** thus lowers the bowl and scraper blade, while contraction thereof hoists the same.

To prevent cylinders **34** from being subjected to the pulling tension between the tractor and earth moving bowl, a pair of swinging towing arms **40** are attached to opposite sides of the bowl by pivotal connections **42** at their rear ends, and are interconnected to hitch subassembly **14** through a cross piece **44** extending between the upper forward ends of these arms **40**. Extension and contraction of cylinder **34** causes these arms to swing through an arc in conventional fashion.

The piston rods of cylinders **32** are connected to legs **50** on opposite sides of the bowl. The opposite end of each of these legs is affixed to an elongated arm **54** intermediate its ends. The rear end of each arm **54** is pivotally ataached at **52** to plate **53** at the side of the bowl while the forward end portion is secured to the upper edge of apron **28**. Extension of cylinders **32** therefore causes arms **54** to swing in a vertical arc upwardly about pivots **52** to elevate the apron. The apron basically is a frontal panel **27** (usually curved) (FIG. **1**) joined to a pair of partial side panels **29** (FIG. **3**). Partial elevation of the apron exposes the scraper blade. Full elevation of the apron fully opens the front end of the bowl to allow emptying thereof by forward movement of a conventional, forwardly-rearwardly sliding rear vertical panel **89** (FIG. **3**). Complete elevation of the apron also hoists the auger assembly in a manner to be described hereinafter.

The auger assembly **60** includes a framework **62** upon which the augers are mounted. The augers are driven by a suitable power supply through mechanical, electrical, hydraulic, or pneumatic connections. This power supply is preferably a supplemental engine such as engine **64** shown mounted in this instance at the rear of the bowl. Conceivably the main tractor engine could be employed, but this is normally not advisable. The drive connections between the engine and the augers are arranged to have sufficient flexibility to accommodate hoisting action of the auger assembly.

The auger assembly includes at least one, and preferably a plurality of individual, vertically oriented augers **70**, here shown to be two in number. These are spaced laterally of each other relative to the direction of movement of the vehicle, each including a shaft **72** and a helical blade **74** therearound terminating at a free unattached lower end positioned close to and above the scraper blade and adjacent dirt inlet. The augers are mounted in the transverse portion of framework **62**. This transverse portion comprises a pair of vertically spaced channel members **76** and **100** extending transversely of the vehicle between and secured at their ends to two spaced parallel upright plate type pillars **78** adjacent opposite sides of the bowl. Uprights **78** have their lower portions fixedly attached to a pair of elongated forwardly-rearwardly extending pivot arms or beams **80**. These are unattached to the bowl itself but are aligned with the bowl side walls to be capable of resting on the upper edges thereof. They are pivotally attached by pins **82** through the rear end of the arms to the upper ends of a pair of mounting brackets **84** fixedly attached as by welding to the rear frame of the bowl vehicle. This entire framework and the augers can be pivoted i.e., swing upwardly through an arc about the rear pivot axis formed by coaxial pins **82**.

Mounting of the auger shafts to cross members **76** and **100** is done in a special fashion as depicted specifically in FIGS. **5**, **6** and **7**. Particularly, the auger shaft extends through an enlarged opening **76'** in cross member **76**, and has around it, and specifically around an enlarged collar **72'** with an annular peripheral flange **72''** thereon, a resilient polymeric support **90**. This support is of deformable resilient material such as natural or artificial rubber or the like, and is secured on top of cross member **76** in sandwich fashion by an upper plate **92**, with bolts **94** extending through cross member **76**, rubber mount **90** and plate **92**. Plate **92** also has an enlarged opening **92'** to prevent shaft contact therewith with swinging shaft deflection to be described. The upper end of each auger shaft **72** is connected into a conventional right angle drive gear housing **98**. Between the gear housing and spaced above the rubber bearing support is a second bearing support and a gear housing stabilizer. The upper bearing support may constitute another resilient support like the one below it, or may, as in the version depicted, constitute a spherical swivel bearing as depicted in FIG. **7**. The important feature is for the auger shaft to be able to pivot in swinging fashion with lateral deflection of the lower end of the auger under laterally applied stresses in any direction within a 360° horizontal circle, as by a rock entering the lower bowl opening. The spherical member **73** fits within the correspondingly shaped cavity of bearing housing **104** mounted on member **100**.

Gear housings **98** are restrained from undue rotation with the augers by a pair of radially projecting restrainers **108** mounted to the underside of the respective gear housings and stabilized relative to the framework. This stabilization is achieved by a first rod **110** interconnected between one stabilizer and the framework **68** (FIG. **5**) by having its bent ends extending through holes in these elements, and a second rod **111** between the two stabilizers and having its bent ends extending through holes therein.

The input drive to the gear housings, in the embodiment depicted, is through a pair of drive shafts **112**, each of which has a universal joint **114** adjacent the gear housings, and a second universal joint **116** adjacent the enlarged pulleys **118** at the rear of the machine. These pulleys are keyed to drive shafts **112** and are in turn driven by drive belts **120** (FIG. **4**). These drive belts are driven from a pair of pulleys **122** coaxially attached to the output shaft of a fluid coupling **124**

driven by the output shaft of internal combustion engine **64** at the rear of the vehicle. This engine can be mounted elsewhere if desired. Also, instead of the illustrated mechanical drive connection from power motor means **64** to the augers, a hydraulic drive arrangement can be used. In that case fluid coupling **124** would be replaced by a hydraulic pump, fluid connecting lines would extend from the pump to hydraulic motors connected to the upper end of the auger shafts. Or compressed air could be used instead of hydraulic fluid. Alternatively, electrical drive means could be used with an electrical generator driven by the power motor means, with electrical lines connecting it to electrical motors driving the augers.

Pulleys **118** are each mounted on a pair of straddling bearings **130,** these bearings being in turn supported on a pair of transverse beams **132** and **134** in front of and behind the pulleys. Beam **132** is mounted on a pair of uprights **136** having their lower ends secured to the framework **138** at the rear of the earth mover (FIG. 4). Beam **134** is mounted on a like pair of uprights **140** having their lower ends also secured to framework **138.** These pulleys, belts, hydraulic coupler and engine are of conventional construction.

The augers and the auger framework are biased to a lowered position by gravity because of the weight of this assembly. The augers and framework, however, can be elevated against this bias by lifting forces. These lifting forces are basically of two types. The first type is a lifting force created by raising of the apron assembly. Specifically, a pair of abutting type cams **150** are (FIG. 2 and FIG. 3) mounted to the forward ends of the apron supporting elevating arms **54** to be in vertical alignment with a pair of upwardly forwardly sloping cam follower surfaces **81** on the forward lower edges of members **80.** Hence, elevation of the apron can cause simultaneous elevation of the auger assembly. Preferably, some lost motion is purposely provided between the elevation of these two components such that the initial elevation of the apron to create a dirt entry opening in the bowl assembly causes little, if any, elevation of the auger assembly. Thus, the apron can be opened a small amount to expose the scraper blade during loading of the bowl, without the augers being moved away significantly from the opening through which the dirt is passing. The augers are therefore immediately available to immediately elevate the dirt away from the opening and prevent the creation of undue back pressures on the dirt entering. However, when the apron is fully opened as during discharge of the bowl, the entire auger framework is elevated to thereby also elevate the augers themselves and move their lower ends upwardly and forwardly (FIG. 3) out of the way of the discharging dirt. This prevents them from unduly hindering dirt discharge. The drive mechanism to the augers accommodates this elevation because of the universal joints in the drive shafts. This is one way in which the auger assembly can be elevated.

The other way in which the auger assembly can be elevated occurs when a particularly large obstacle such as a large rock is encountered during the loading operation. In this instance, the upward force of the rock on the auger or augers causes the auger assembly to swing upwardly around pivot pins **82** until the rock is shifted into the earth mover out of the range of the augers. Thereupon, the weight of the auger assembly causes it to return to its primary lowered position.

Simultaneously with this vertical elevation, or alternately with this vertical elevation, is the lateral shifting characteristic of the augers. That is, if a rock or the like should catch between the two augers or should otherwise encounter one of the augers and apply a lateral thrust in any direction within the **360** degrees of a plane normal to the auger axis, the lower free end of the auger can deflect away from this applied force, against the bias of the resilient rubber mounting **90,** to accommodate passage of the obstacle. As soon as the obstacle passes the auger, the inherent bias of the resilient mounting member **90** returns the auger to its initial position. As noted, this lateral deflection can occur simultaneously with elevation of the auger. Vertical alignment of the auger assembly is normally maintained relative to the sides of the bowl assembly, even during elevation of the augers because of a rock being encountered or the like, by having the lower end portions of the uprights **78** extend below the upper edges of the bowl side walls, and preferably flared laterally outwardly to act as vertical guides.

Although the operation of the novel apparatus is apparent from the previous detailed description, a brief description of the sequence will be set forth for certain clarity. Specifically, in use of earth moving vehicle **10** with tractor **12,** interconnected in articulated fashion by hitch **14** to bowl type earth scraper **16,** assuming that the bowl is empty, and the tractor engine and auxiliary engine are operating, hydraulic cylinders **32** are activated a small amount to elevate the apron sufficiently to create an earth receiving opening ahead of scraper blade **17.** Then, hydraulic cylinders **34** are activated to drive the forward end of the bowl and scraper blade down into engagement with the earth. With internal combustion engine **64** driving the augers through the drive train assembly, when the tractor moves forwardly to cause earth to pass over the scraper blade, the lower ends of the augers immediately hoist the earth away from the opening to allow the structure to fill. Repeated experimental operations show that the entire bowl of medium capacity can be readily filled within a matter of 30 to 50 seconds. The apparatus will accommodate various types of earth including abrasive sand or "dead earth," rocks, ground with a heavy frost layer, or clay. The vehicle is self-loading, requiring no dozer or other equipment to assist it. If a rock of substantial size or other obstacle is encountered, the rapidly rotating augers can deflect laterally and/or vertically to enable the rock to pass without damaging the auger units themselves or the framework upon which they are suspended. During normal filling, the auger assembly frequently bounces and shifts repeatedly, because of its floating type arrangement. It is believed that this assists in effective breaking up and loading of all types of dirt, as well as in handling obstacles. In fact, the dirt appears to actually "boil up" into the bowl.

When the bowl is full and the load is to be transferred to another location, the apron is normally closed by retracting cylinders **32** to prevent spillage. When the location is reached at which the load is to be discharged, cylinders **32** are fully extended to elevate the apron to its full open condition, thereby opening the front of the bowl and simultaneously hoisting the auger subassembly until the augers are basically out of the path of the earth being discharged. The earth is then discharged as by a forwardly moving power driven plate **89** (FIG. 3), or other equivalent unloading means. After discharge,

plate 89 is withdrawn rearwardly to its initial position, and the apron assembly is lowered, thereby lowering the auger assembly simultaneously. The unit is then ready to receive its next load.

It is conceivable that those knowledgeable in this art will readily visualize that the auger assembly can be attached to various models of bowl type earth moving equipment presently available on the market. In fact, representatives of large companies manufacturing bowl type units presently, upon viewing the experimental operation of the apparatus have indicated that the unit could be readily attached to their new or used equipment and could be driven hydraulically and/or electrically and/or by other alternative equivalent mechanical means to that depicted herein. The depicted illustrative mechanical arrangement was preferred by the individual inventor for ease of altering operating parameters during experimentation. The alternative drive arrangements might be preferred for other reasons such as cost, use of components common to earth moving equipment manufacturers, and the like. The structure has particular advantages to smaller operators who cannot afford expensive supplemental equipment to assist in the loading operations. Also, in the event of damage to the auger assembly, or other reason for removal thereof, this can be quickly and easily done by pulling pivot pins 82, disconnecting the drive connections to the augers, and hoisting it out. Obviously use of hydraulic drive with standard disconnect couplings on the market would be simple also. Hence, these modifications which could be readily made to the equipment by those in the art are clearly within the scope of the invention which is intended to be limited only by the scope of the appended claims and the reasonable equivalents thereto rather than to the specific embodiment depicted herein as representative of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An earth moving vehicle comprising: in combination with a bowl assembly having an underside earth inlet opening and a scraper blade adjacent said inlet; an auger assembly having at least one generally vertically arranged auger in said bowl assembly having a lower free end generally adjacent said opening and power motor means operably connected to said auger to rotate it; the improvement comprising: a framework supporting the upper end portion of said auger, said upper end portion including an auger shaft, and said framework including bearing support means around said auger shaft, said bearing support means including laterally shiftable portions to allow said auger lower end to laterally shift temporarily in response to side thrust, said framework being mounted to said bowl assembly with a connection allowing said framework and said auger assembly to be vertically movable relative to said bowl assembly, enabling said auger to be vertically shiftable in response to lifting thrust for passage of obstacles such as rocks entering said bowl assembly.

2. The combination in claim 1 wherein said framework is pivotally mounted to said bowl assembly on a radius at a substantial angle to the axis of said auger to accommodate said vertical movement.

3. The combination in claim 1 wherein said framework is pivotally mounted to said bowl assembly toward the rear thereof relative to said opening.

4. The combination in claim 3 wherein said framework includes a pair of arm assemblies adjacent opposite sides of said bowl assembly and extending toward the rear of said bowl assembly for pivotal mounting thereto.

5. The combination in claim 1 wherein said bowl assembly includes an apron, and apron elevating means to lift the apron and open the bowl assembly for contents discharge, and said apron elevating means and auger framework being operably coupled to vertically move said framework and auger with lifting of said apron for contents discharge from said bowl assembly.

6. The combination in cliam 1 wherein said bearing support means includes resilient bearing means positioned to allow limited lateral shift of the auger.

7. The combination in claim 1 wherein said bearing support means includes two vertically spaced support means for said auger shaft, the upper one having a swivel action allowing the auger to swing thereabout and the lower one having resilient restraining means surrounding the auger shaft to limit lateral swinging movement of the auger shaft while applying a return bias thereto.

8. The combination in claim 6 wherein said resilient bearing means comprises a resilient rubbery cushion.

9. An earth moving vehicle comprising: in combination with a bowl assembly having an underside earth inlet opening and a scraper blade adjacent said inlet; an auger assembly having at least one generally vertically arranged auger in said bowl assembly having a lower free end generally adjacent said opening and power motor means operably connected to said auger to rotate it; the improvement comprising: a framework supporting the upper end portion of said auger, said upper end portion including an auger shaft, and said framework including bearing support means around said auger shaft, said bearing support means including laterally shiftable portions, and means limiting the lateral shifting thereof to a controlled amount, to allow said auger lower end to temporarily laterally shift in response to side thrust, allowing passage of obstacles such as rocks entering said bowl assembly.

10. The combination of claim 9 wherein said bearing support means includes a swivel bearing to allow lateral swinging shift of said auger lower end, and lateral shift limiting means.

11. The combination in claim 9 wherein said bearing support means includes two vertically spaced bearing means around said auger shaft, the upper one having a swivel action to allow the auger therebelow to swing relative thereto, and the lower one being a resilient cushion to limit lateral shaft movement while also applying a return bias thereto.

12. An earth moving vehicle comprising: in combination with a bowl assembly having an underside earth inlet opening and a scraper blade adjacent said inlet; an auger assembly having at least one generally vertically arranged auger in said bowl assembly having a lower free end generally adjacent said opening and power motor means operably connected to said auger to rotate it; the improvement comprising: a framework supporting the upper end portion of said auger, said upper end portion including an auger shaft, said framework including bearing support means around said auger shaft, said framework being mounted to said bowl assembly with a connection allowing said framework and

said auger assembly to be vertically movable relative to said bowl assembly, enabling said auger to be vertically shiftable in response to lifting thrust for passage of obstacles such as rocks entering said bowl assembly.

13. The combination of claim **12** wherein said framework is pivotally mounted to said bowl assembly on a radius at a substantial angle to the axis of said auger to accommodate said vertical movement.

14. The combination in claim **12** wherein said framework includes a pair of arm assemblies extending toward the rear of said bowl assembly along opposite sides thereof and pivotally mounted thereto.

15. The combination of claim **12** wherein said bowl assembly includes an apron, and apron elevating means to lift the apron and open the bowl assembly for discharge, and said apron elevating means and auger framework being operably coupled to vertically shift said framework and auger with lifting of said apron to open the bowl assembly for discharge.

16. An auger attachment assembly for an earth moving vehicle having a bowl assembly with an underside earth inlet opening and adjacent scraper blade comprising:

a framework having a pair of spaced arm assemblies with pivot connections for pivotal attachment to opposite sides of a bowl assembly; at least one vertical auger having an upper end shaft mounted on said framework; said framework including bearing support means around said auger shaft, said bearing support means including shiftable portions and biasing means opposing shifting thereof, allowing limited lateral shift of the lower end of said auger in response to side thrust.

17. The auger attachment assembly in claim **16** wherein said bearing support means includes a swivel bearing to allow lateral shift of said auger lower end, and including lateral shift limiting means.

18. The combination in claim **16** wherein said bearing support means includes two vertically spaced bearing means around said auger shaft, the upper one having a swivel action to allow the auger therebelow to swing relative thereto, and the lower one being resilient to allow only limited lateral shaft movement while applying a return bias thereto.

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