Oct. 13, 1970 W. CARSTON 3,533,174

EARTH-MOVING MACHINE WITH LOAD-DISTRIBUTING AUGER

Filed Jan. 10, 1968 2 Sheets-Sheet 1

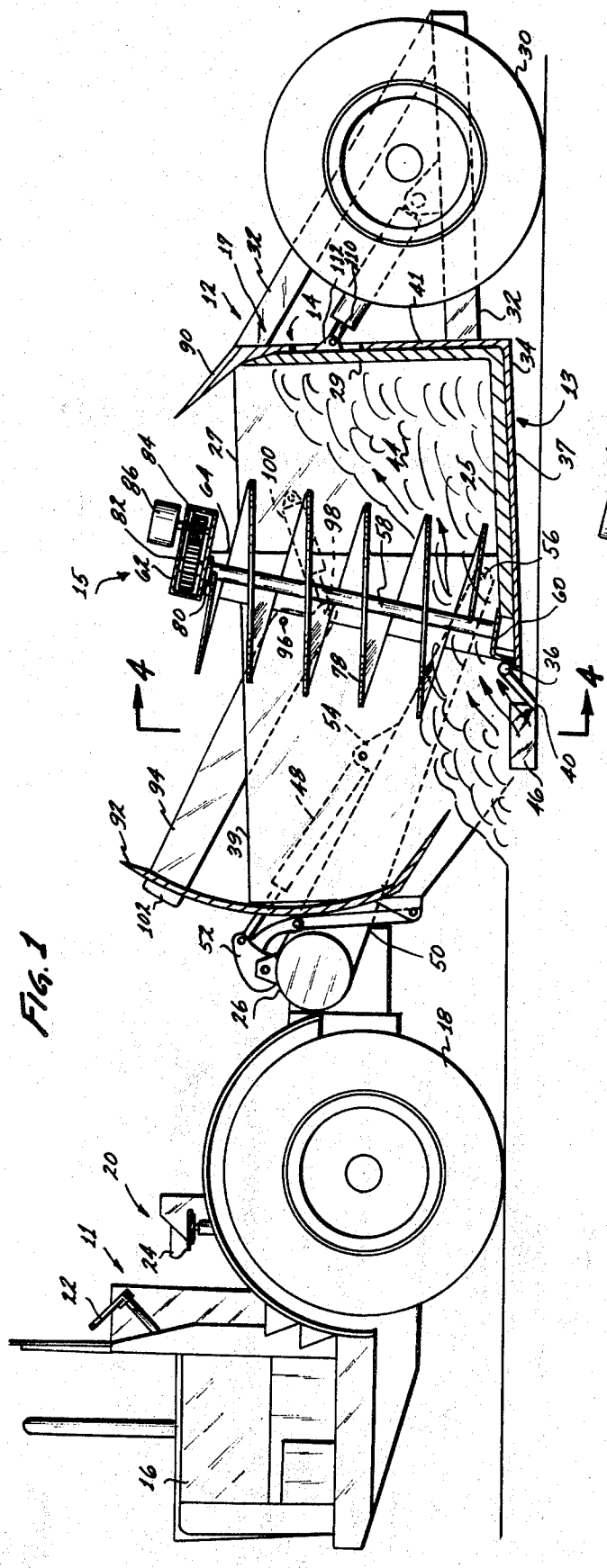


FIG. 1

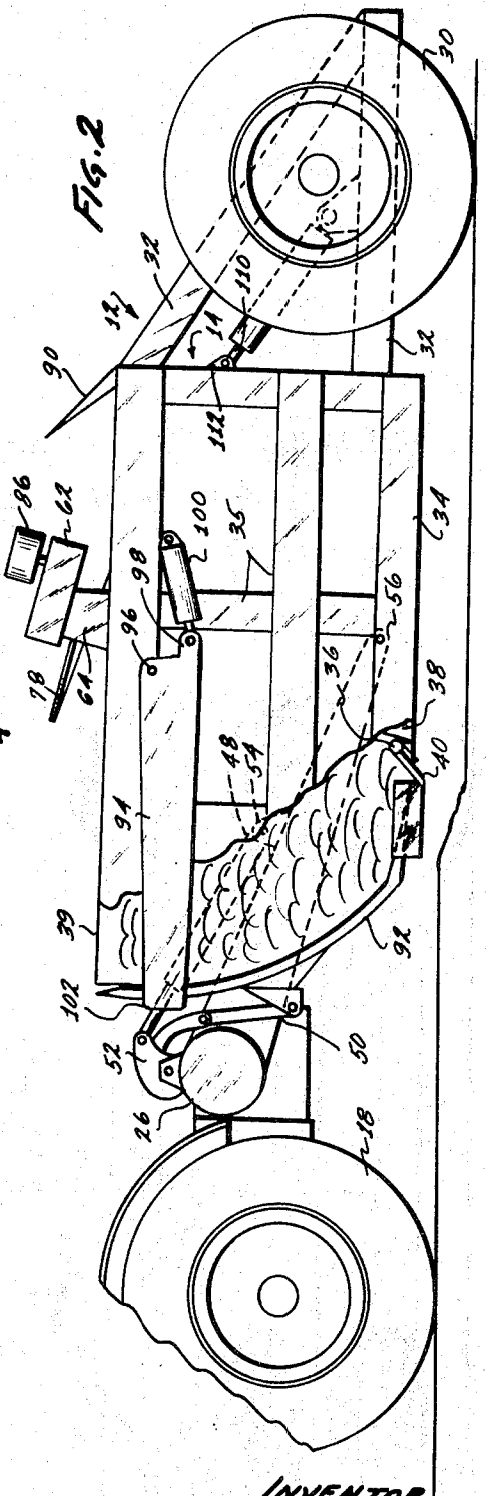


FIG. 2

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FIG. 5

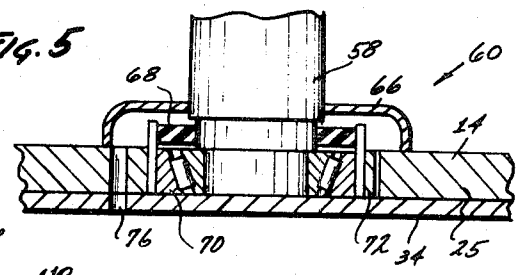


FIG. 3

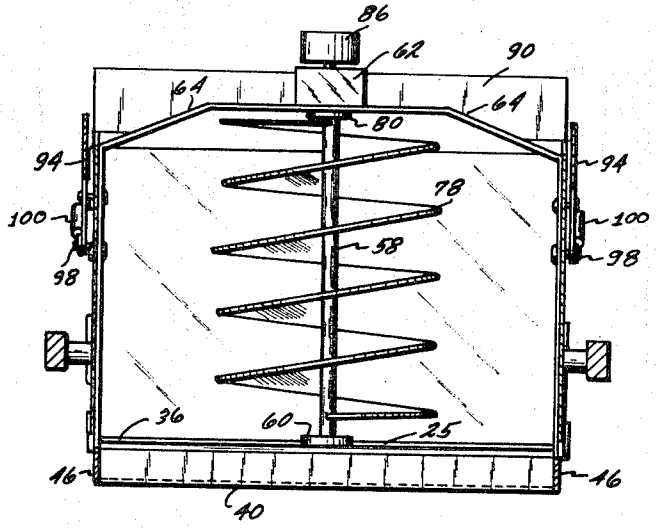


FIG. 4

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3,533,174

EARTH-MOVING MACHINE WITH LOAD-DISTRIBUTING AUGER

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Int. Cl. E02f 3/62
U.S. Cl. 37—8 4 Claims

ABSTRACT OF THE DISCLOSURE

A self-loading earth mover is disclosed including a scoop-like transport bowl, borne on wheels, which bowl incorporates a cutting blade at its forward end to break up earth for progressive movement into the bowl as the machine moves forward. An auger or screw structure is centrally mounted in the bowl in a position so that its axis is slightly offset from vertical and it functions to distribute and compact the earth load in the bowl as it is received. A front apron or gate is also provided in the structure to close the forward end of the bowl during periods when a load is to be transported. Structure is also included for unloading the bowl by tiltingly lifting it relative to its bed so that the auger is also tilted forward from the vertical (toward the open side of the bowl) to thereby assist in discharging the load through the forward end from which it is spilled.

BACKGROUND AND SUMMARY OF THE INVENTION

Earth-moving machines of the type generally termed motor scrapers have been proposed in a wide variety of different forms for specific applications and capability. However, almost invariably, a problem in the design and manufacture of such machines involves the provision of a loading arrangement to effectively distribute and compact the load as it is received in the bowl, so as to effectively utilize the capacity of the machine. As a related consideration, the system also must have the capability to discharge its load cleanly and effectively; as well, ideally at a somewhat controlled rate.

Considering the problem in greater detail, in accordance with conventional practice, motor scrapers are driven over the terrain which is to be modified and in the course of such movement they perform cuts and fills in the earth to accomplish the desired configuration. Conventionally, the cutting blade is fixed at the forward edge of the scraper can or bowl, so that earth that is cut loose by the cutting blade flows into the bowl as the machine moves forward. However, loading a motor scraper to capacity by this technique alone generally is not effective. That is, usually (except in ideal soil) the flow of earth into the bowl that is attendant the forward motion of the machine, does not develop the desired load distribution in the bowl, nor does it compact the load. As a result, many different types of loading structures have been proposed for cooperative use with motor scrapers to accomplish a dense, well distributed load with earth that is received from the cutting blade or scraper. Although certain forms of such structures have been relatively efficient, a substantial need continues to exist for a loading system which will operate in cooperation with a transport bowl and which will provide increased operating efficiency by compacting the received load in a well distributed pattern and which may be incorporated in various forms of earth-moving apparatus.

In general, the present invention resides in the discovery that an earth auger or helical screw member, of somewhat critical size, may be mounted in a somewhat critical (generally vertical) position within the bowl of an earth-moving apparatus, and operated at a somewhat critical speed to accomplish very effective loading of the bowl. The auger is fixed in the bowl in such a manner as to receive loose earth from a cutting blade as the bowl is moved forward, and is employed during both loading and unloading operations to accomplish dense loads during loading, and effective removal of such loads from the bowl during unloading.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partly-sectional side elevation of a motor scraper incorporating the present invention;

FIG. 2 is a fragmentary view similar to FIG. 1, showing the motor scraper loaded with earth as for transport operation;

FIG. 3 is a fragmentary view similar to FIG. 1 showing the motor scraper in a configuration to discharge a load of earth;

FIG. 4 is a vertical sectional view taken along line 4—4 of FIG. 1; and

FIG. 5 is an enlarged sectional view taken vertically through a portion of the structure of FIG. 1.

DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENT

As required, a detailed illustrative embodiment of the present invention is disclosed herein. However, it is to be understood that the embodiment merely exemplifies the invention which may be constructed in many different forms that are radically different from the specific relatively-small motor scraper disclosed herein. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely considered as a basis for the claims defining the true scope of the invention.

Referring initially to FIG. 1, the unit is shown to include a tractor **11** coupled to a trailer **12** incorporating a can or bowl **13** carried on a chassis along with the loading structure hereof, generally indicated at **15**. As indicated above, it is to be stressed that although the exemplary structure discloses a drawing tractor, the system hereof may take a variety of different forms wherein the bowl is variously pushed, pulled, self-propelled, or otherwise moved in a manner to cut and/or scrape earth so as to accumulate a load which is received and distributed by the structure **15**.

As disclosed herein, the tractor **11** may be a somewhat conventional machine including an engine **16**, driving wheels **18**, and an operator's station **20** at which a steering wheel **22** and a seat **24** are provided. The operator will also be provided with various hydraulic controls (not shown) for the operation of the trailer **12** to accumulate a load and discharge it. However, various hydraulic systems as well known in the prior art may be employed to control the hydraulic motors and actuators as described below, and such well-known apparatus is therefore not described in detail. Also, the engine **16** will normally function to provide hydraulic fluid under pressure for utilization by various controls as well known in the prior art.

The tractor **11** is coupled to the trailer **12** by a hitch **26**, which may comprise any of a variety of conventional universal structures as well-known in the art, and which permits pivotal motion between the tractor **11** and the trailer **12**, yet affords a positive enagement therebetween and a reference for cut adjustments.

In the trailer **12** the bowl **14** comprises a somewhat-open scoop structure including a bottom **25**, two sides **27**, and rear or back wall **29**, all supported on the reinforced, mating chassis **14**, the rear end of which is borne on a running gear including wheels **30**.

The chassis **14** may comprise a plurality of steel beams **32**, welded or otherwise fixed together with wall sections

as an integral unit, which defines a bed **34** that nestingly receives the bowl **13**. More specifically, the exterior of the bed **34** includes an array of reinforcing beams **35** (FIG. 2) which support a bottom **37** (FIG. 1), sides **39**, and a rear wall **41**, all of the bed **34**.

At the forward end of the bed **34**, (which is fixed relative the frame **28**) a pivot structure **36** joins the bed to the bowl **13** whereby the bowl can be tilted forwardly to discharge a load of earth. Considering this structure in greater detail, the forward edge **38** of the bowl **13** is affixed to the transverse pivot **36** which is supported in the bed **34**. A cutting blade **40** then extends forward and downward from the pivot structure **36** opposed to the bowl **13**.

As shown in FIG. 1, the cutting blade **40** is somewhat angularly offset from alignment with the bottom of the bowl **13**; however, it is wedge-supported to be fixed against counterclockwise motion about the pivot structure **36**. Thus, the blade **40** may be directed into an earth cut so as to feed loose earth into the bowl **13** and to the loading structure **15** (FIG. 1) which distributes and compacts the earth load **44** in the bowl **13**. In this regard, it is to be noted that the cutting blade **40** is led by a pair of side bits **46** affixed at the forward lower sides of the chassis **14**. The bits **46** accomplish leading earth cuts defining the cut for the blade **40**.

The actual depth of an excavation or earth cut is determined by the level at which the blade **40** operates, which is established by a hydraulic actuator **48** (FIG. 1, shown in phantom) which is affixed between draw bars or towing arms **50** and the rigid coupling **26**. More specifically, the hydraulic rams or actuators **48** extend from extension arms **52** rearward to be affixed to the pulling or drawing arms **50** by a pair of brackets **54** (shown in phantom). The rear ends of the drawing arms **52** are then affixed to the base of the chassis **14** by a pivot structure **56**. Therefore, by variously adjusting the length of the actuators **48**, the front end of the pivoted chassis **14** is variously raised and lowered so as establish the operating level of the cutting blade **40**.

Earth that is excavated by the blade **40** flows into the bowl **13** to feed the loading structure **15** and become distributed as will be considered in detail below. However, preliminarily considering the component parts of the structure **15**, a central stem or axle **58** of the screw auger is mounted between sets of self-aligning bearings for low-friction rotation. Specifically, the lower end of the axle **58** is received in a floor housing **60** while the upper end is fixed into a gear box **62** that is held in place by a transverse frame or yoke **64** (FIG. 4) extending between the sides **27** of the bowl **13**. The lower end of the auger axle **58** (FIG. 5) carries a turret flange or shield **66**, below which it is stepped to be received through a seal **68** and into a self-aligning bearing **70** that is set in a bearing cage **72**, surrounded by a circular array of bores **76** through the floor of the bowl **13**. These bores provide an exit for earth which slips under the shield **66**.

Above the housing **60** (FIG. 1) the auger axle **58** supports a screw auger **76** having a relatively shallow pitch and terminating at the gear box **62**. The gear box **62** incorporates a bearing **80** for supporting the auger axle **58** and encloses a pair of gear wheels **82** and **84**, which couple the auger axle **58** to a drive motor **86**.

In the illustrative embodiment, the drive motor **86** is hydraulic and may be driven from a source of hydraulic fluid under pressure provided from the engine **16** of the tractor as disclosed above. Of course, in various other arrangements incoroprating the present invention, the motor **86** may take different forms or may be differently powered.

In view of the above, preliminary structural description of the embodiment illustratively presented herein, a complete understanding may now best be accomplished by assuming certain desired objectives, then explaining the attendant sequence of events concurrently with the introduction of additional component parts. Therefore, assume initially that the system is being drawn forward by the tractor **11** and is cutting earth to develop a load **44** substantinally as shown in FIG. 1. As the unit moves forward, the side bits **46** define a section of earth with small trenches, which section is then excavated by the blade **40** and lifted, in somewhat of a flowing manner, to be received by the screw auger loading structure **15**. As the dirt flows upwardly to the screw auger **78**, it is lifted by the helical motion pattern upwardly and outwardly to be compacted within the bowl **13**. The movement of the dirt or earth by the auger loading structure **15** is sufficiently forceful to compact the earth about the screw auger **78**, developing a channel through which fresh earth may pass to the upper surface of the load.

In general, the loading structure **15** may be operated at a wide variety of speeds; however, in one successful operating embodiment hereof speeds between 200 and 300 revolutions per minute have been found particularly effective for a rather wide range of soils, using a screw auger with a pitch of less than thirty degrees.

As another somewhat critical feature of this structure, it is to be noted that the auger **78** is tilted from the horizontal at a slight angle toward the rear or load-receiving portion of the bowl **13**. Again, certain installations may require particular structures; however, in one successful operating embodiment hereof, it has been found desirable to offset the auger **78** from the vertical by an angle of less than 25 degrees, e.g., 15 degrees in a specific example to accomplish successful loading as well as to accommodate the forward tilt of the bowl **13**.

Still another somewhat-critical aspect of the structure resides in the size of the auger **78**. It has been found desirable to provide the width of the auger **78** less than half the width of the cutting blade **40** (FIG. 4). That is, it has been established that the flow of earth received from the cutting blade **40** by the auger **78** should be substantially wider than the operating width of the auger. In general, although this criterion is not readily apparent, it results from the application in which the auger is loading earth into its housing rather than moving earth through a housing.

Considering the operation hereof further, as the unit continues to move forward, earth continues to flow into the bowl **13** to be distributed by the auger structure until the load **44** reaches a guard **90** (extending across the rear of the chassis **14**). At such a time (when the bowl **13** is substantially full) the front portion thereof is closed by dropping an apron or gate **92** into a lowered position substantially as shown in FIG. 2. The gate **92** is carried on a pair of external lever arms **94** which are pivotally affixed to the chassis **14** by pins **96**. An offset extension **98** from each of the arms **94** is then pivotally affixed to hydraulic rams or actuators **100** as a bell-crank, so that as the actuators **100** are collapsed, the forward ends **102** of each of the arms **94** are lowered through a counterclockwise pattern placing the gate **92** in a closed position (abutting the cutting blade **40**).

With the forward gate **92** lowered to a closed position, as shown in FIG. 2, the load may be transported to the location at which it is to be discharged. Normally, during such a period of movement, the hydraulic motor **86** (driving the screw auger **78**) is deenergized so that the auger remains motionless.

Upon reaching the physical location at which the load **44** is to be discharged, the forward gate **92** is first raised to at least a partly open position. Next, the bowl **13** is tilted forward, in a counterclockwise direction as shown relative the chassis **14**, thereby lifting the load **44** to a spilling position as indicated in FIG. 3. Considering the operation of discharging the load **44** in somewhat greater detail, the forward gate **92** is raised by actuating the hydraulic actuators **100** to extend their length so as to crank the arms **94** (substantially as bell-cranks) clock-

wise about the pivot pins **96** so that the gate **92** is elevated clear of the load. Subsequently, the bowl **13** is tipped forward under the force of a telescopic hydraulic ram or actuator **110** (FIG. 3). The actuator **110** is affixed to an extension **112** from the rear wall **29** of the bowl **13**, so that as the actuator **110** expands telescopically, the load **44** is spilled forwardly passing through the auger structure **15**.

In discharging of the load **44**, it is generally advisable to operate the auger structure **15** by energizing the motor **86**, which operation tends to aid in spreading the dirt effectively during a fill operation. That is, in some instances, discharging a load from a bowl deposits a concentrated mass of earth. However, by the utilization of the present system, the auger structure **15** may be employed to discharge the earth so that it is spread more uniformly as it passes from the bowl **13**.

Thus, the structure hereof includes several important aspects, as considered above, the major of which resides in the efficient operation resulting from better load distribution and the facility of a unit to accomplish a relatively compact load without auxiliary tamping or other structure. Of course, as indicated above, the system hereof may be readily adapted to provide a wide variety of different specific structures and may be incorporated in a wide variety of different machines; therefore, the system as disclosed herein is to be deemed merely an exemplary embodiment and the scope hereof shall not be restricted accordingly but rather shall be interpreted in accordance with the claims set forth below.

What is claimed is:

1. A self-loading earth moving machine, adapted to be moved between loading and unloading positions, comprising:

a bowl structure for receiving a load of earth and including a bottom and means for providing an opening in the front of said bowl structure through which earth is received;

means for propelling said bowl structure forwardly over earth to be excavated;

cutter means affixed at the front of said bowl structure at said opening, for excavation of earth into said bowl through said opening as said bowl is propelled over earth to be excavated, and

an open, unshielded screw auger, including an axle, mounted in said bowl with the lower end of said axle mounted for rotation on said bowl bottom rearward of said opening of said bowl, said auger being tilted rearward from its mounting on said bowl bottom to define an angle with the vertical, of between 5 degrees and 25 degrees, whereby said auger receives excavated earth from said cutter means to distribute such earth in said bowl structure.

2. A machine according to claim **1** wherein said auger includes drive means for turning said auger at between 200 and 300 revolutions per minute.

3. An earth moving machine according to claim **1** wherein said bowl comprises an open-ended scoop and wherein said cutter means is affixed thereto, and further including means for tilting said scoop whereby to discharge the contents thereof over said cutter means.

4. A machine according to claim **1** wherein said auger has a width of less than one half of the width of said cutter means and said machine further includes means to tilt said auger to a position in which it is inclined to the vertical in a direction opposite to said tilted direction during unloading of said bowl structure.

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