Aug. 5, 1952 B. O. ACKER, JR 2,606,013

EXCAVATING APPARATUS

Filed Nov. 2, 1949 3 Sheets-Sheet 1

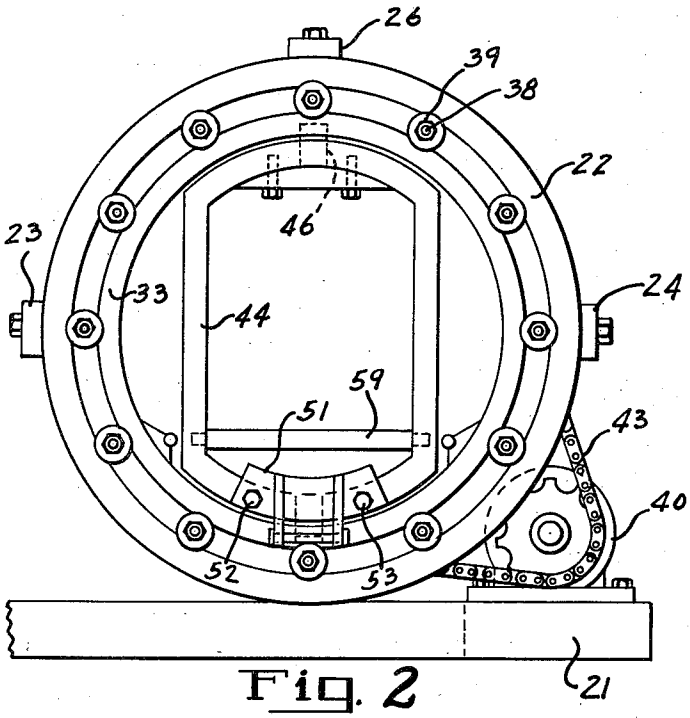


Fig. 2

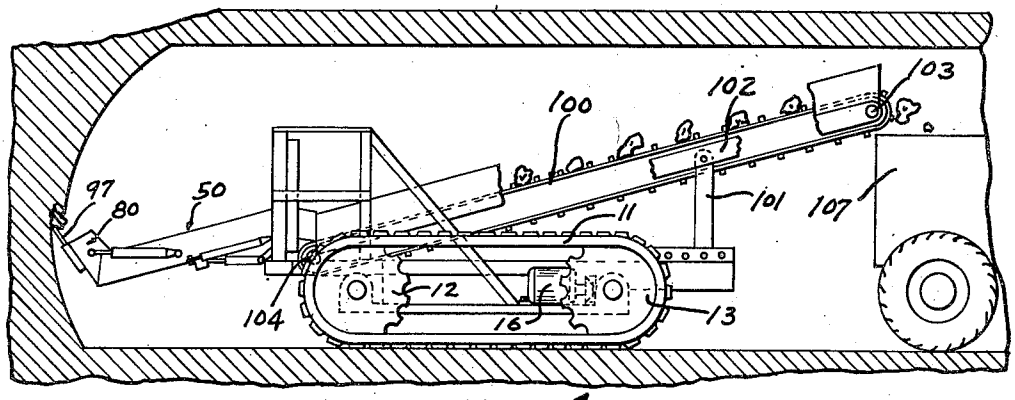


Fig. 1

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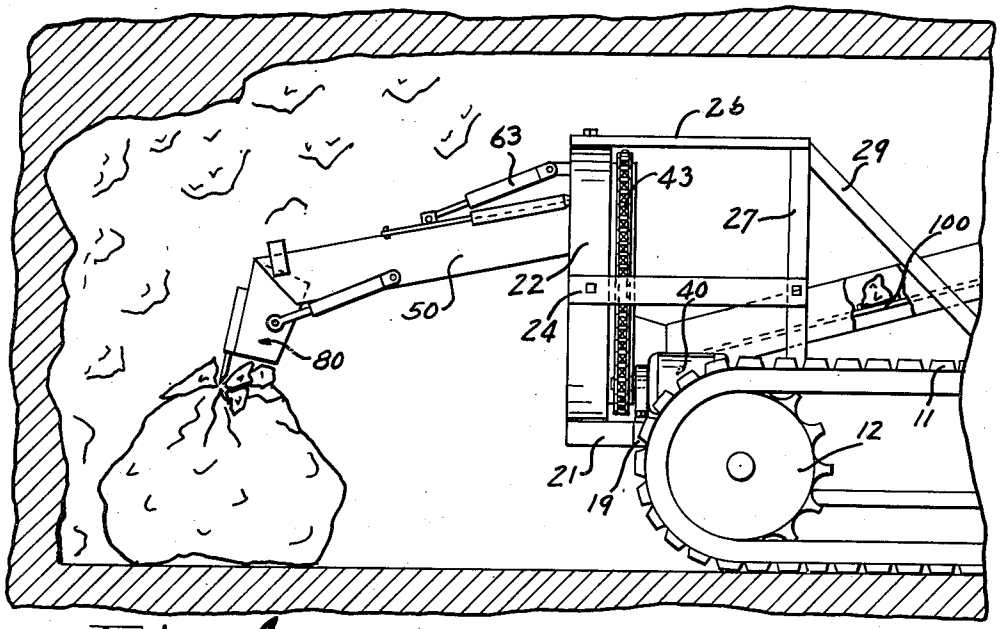


Fig. 4

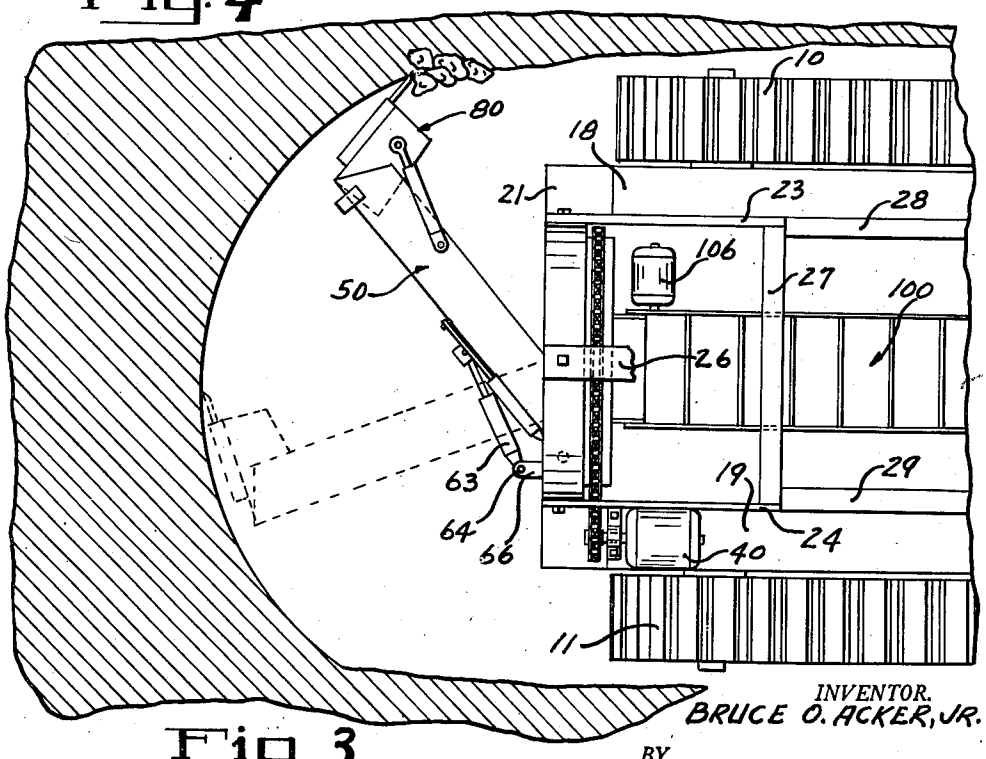


Fig. 3

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EXCAVATING APPARATUS

Filed Nov. 2, 1949 3 Sheets-Sheet 3

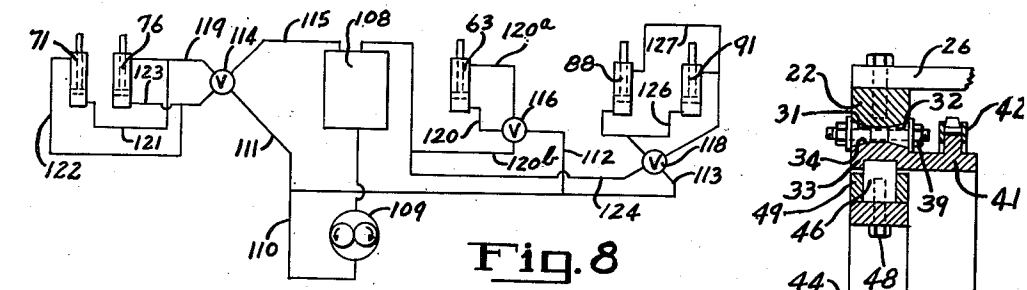


Fig. 8

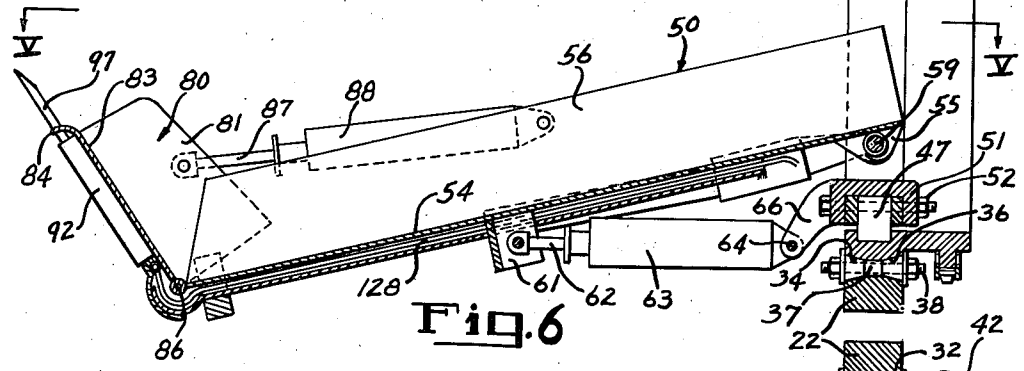


Fig. 6

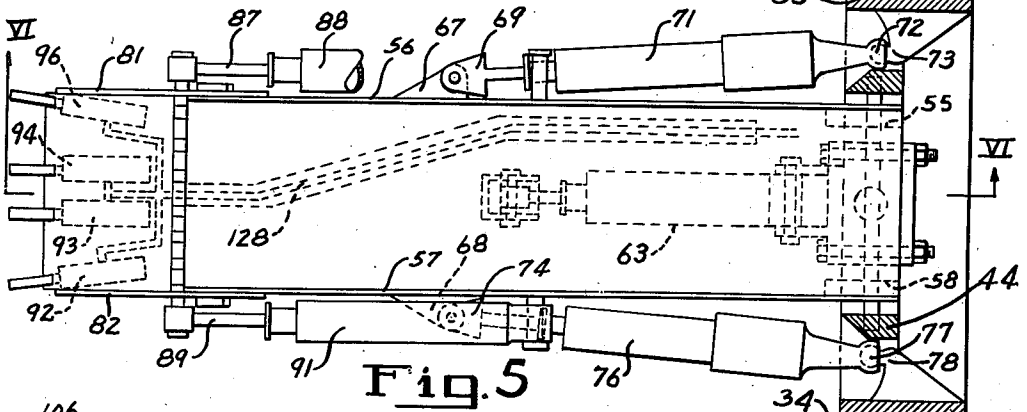


Fig. 5

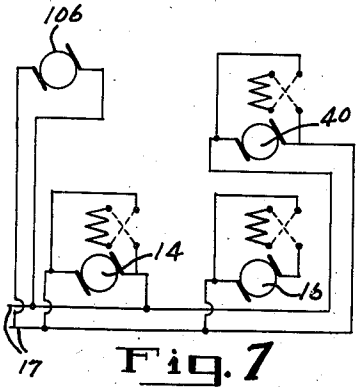


Fig. 7

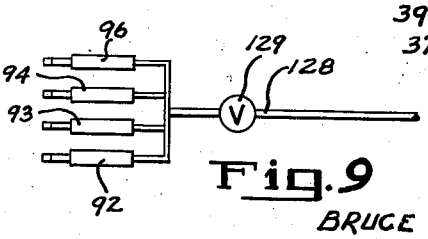


Fig. 9

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Patented Aug. 5, 1952 2,606,013

UNITED STATES PATENT OFFICE

2,606,013

EXCAVATING APPARATUS

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Application November 2, 1949, Serial No. 125,016

8 Claims. (Cl. 262—13)

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This invention relates to earth excavating machinery, and particularly to a machine adapted for mining ore and coal, and has for an object the provision of apparatus of the character designated which shall be simple and sturdy of design, reliable and flexible in operation, and one which shall be capable of breaking down relatively hard, dense formations which have heretofore required explosives to break them.

A further object of my invention is to provide excavating apparatus including a dipper carrying vibratory percussive type drills, together with improved means for manipulating the dipper and to remove the material as it is excavated.

A more specific object of my invention is to provide excavating apparatus which shall include a dipper carrying vibratory, percussive type drills on its under side, projecting forwardly from its engaging edge and in which said dipper shall be pivotally mounted on a conveyer trough to deliver excavated material thereinto, and in which the trough is pivotally mounted at its opposite end to move angularly in all directions.

Briefly my invention comprises a self propelled vehicle having a stationary outer ring mounted at the front thereof to stand vertically and transversely of the vehicle. An inner ring is mounted to rotate within the outer ring, and a trough is pivotally mounted within the inner ring to extend forwardly of the vehicle and to swing horizontally and vertically with respect thereto. A dipper is hingedly mounted on the forward end of the trough and has mounted thereon a plurality of vibratory percussive cutting tools, such as the well known jack hammers, extending forwardly from the engaging lip thereof. These tools engage the working face of the material being excavated and cause it to fall in the trough. The vibration of the tools causes the trough to vibrate and convey the material rearwardly thereof. A conveyer is mounted at the rear of the trough to receive the material and convey it rearwardly of the vehicle.

Other important features of my invention include the manner in which the rings are mounted and the manner in which the trough is mounted within the inner ring; also the means for actuating the trough, the dipper and the inner ring. All of these and other novel features of my invention will become apparent from the following detailed description and from the annexed drawings forming a part of the application, in which:

Fig. 1 is a side elevation with parts broken away showing my improved apparatus;

Fig. 2 is a front elevation of the rings and yoke in which the trough is mounted with the trough removed;

Fig. 3 is a plan view of the front of the apparatus:

Fig. 4 is a side elevational view of the forward

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end of the apparatus showing the trough and dipper in an inverted position;

Fig. 5 is a sectional plan view taken along the line V—V of Fig. 6;

Fig. 6 is a sectional view taken along the line VI—VI of Fig. 5;

Fig. 7 is a wiring diagram;

Fig. 8 is a piping diagram for the hydraulic cylinders; and

Fig. 9 is a piping diagram for the pneumatically operated jack hammers.

Referring now to the drawings for a better understanding of my invention, I show a track laying vehicle having the well known "Caterpillar" treads 10 and 11 mounted on forward wheels 12 and rear wheels 13 and driven by individual reversible motors 14 and 16. See Fig. 7. The power circuit for the motors is indicated at 17 in Fig. 7. The vehicle is provided with longitudinal frame members 18 and 19 and a suitable number of transverse frame members 21.

Mounted on the forward end of the frame members to stand vertically and transversely of the vehicle is an outer stationary ring 22. The ring 22 is held against movement relative to the frame by attachment to the forward end of the frame members just described and by lateral braces 23 and 24 and a top brace 26 which extend rearwardly. The braces 23, 24 and 26 are joined to a U-shaped member 27, which is in turn connected by downwardly extending braces 28 and 29 to the side frame members. The outer stationary ring 22 is provided on its inner surface with double beveled bearing seats 31 and 32.

Mounted to rotate within the outer ring 22 is an inner ring 33, having double beveled bearing surfaces 34 and 36 which are similar and opposed to the bearing surfaces 31 and 32. Interposed between the two rings 22 and 33 are double conical bearings 37 which are mounted on through spindles 38 and held in place by means of nuts 39. The ring 33 is provided with a rearward extension 41 having sprocket teeth 42 formed thereon. The ring 33 may be rotated with respect to the outer ring 22 by means of a reversible motor 40 driving a sprocket chain 43 which passes around the sprocket teeth 42. As shown in Fig. 7, the motor 40 derives its power from the circuit 17.

Mounted within the inner ring 33 is a yoke 44. The yoke 44 is vertically pivoted to the inner ring 33 by means of an upper pivot pin 46 and a lower pivot pin 47. The pivot pin 46 is held in place by means of a stud 48 which passes upwardly through the yoke and through an arcuate reinforcing member 49 provided on the upper end of the yoke. The lower pivot pin 47 is held in place by passing downwardly through the yoke 44 and by a U-shaped bracket 51 the sides of which extend downwardly about the yoke 44 and by bolts 52 and 53 which hold the bracket in place.

Extending forwardly of the vehicle is a trough 50 having a bottom 54 and sides 56 and 57. At the rear of the trough on the underside of the bottom 54 are brackets 55 and 58 through which

a pin 59 passes, having its ends mounted in the yoke 44, thereby to provide a horizontal pivot for the rear of the trough. It will be noted that the pin 59 is located considerably below the center of the yoke 44 and inner ring 33 whereby, when the trough is in its normal position as shown in Fig. 6 the rear end is considerably lower than when in an inverted position as shown in Fig. 4.

Mounted on the underside of the bottom 54 of the trough is a bracket 61 to which is pivotally connected the piston rod 62 of a hydraulic cylinder 63. The opposite end of the hydraulic cylinder 63 is pivotally connected at 64 to an arm 66 forming a part of the bracket 51. By means of the hydraulic cylinder 63, the trough may be moved angularly with respect to its pivot 59. Connected to the sides 56 and 57 of the trough respectively, near the bottom, are brackets 67 and 68. Pivotally connected to the bracket 67 is the piston rod 69 of a hydraulic cylinder 71. The opposite end of the cylinder 71 is connected to the inner rotary ring 33 by a ball and socket joint 72 and 73. Connected to the bracket 68 is the piston rod 74 of a hydraulic cylinder 76, which cylinder is connected to the inner rotary ring 33 by a ball and socket joint 77 and 78. It will be seen that by means of the hydraulic cylinders, the trough and its yoke 44 may be moved angularly with respect to the rings 22 and 33.

Pivotally mounted to the outer end of the trough 50 is a dipper 80 having sides 81 and 82 and a bottom 83 with a material engaging lip 84. The sides 81 and 82, as may be seen in Figs. 5 and 6, overlap the sides 56 and 57 of the trough 50. The dipper is pivoted to the bottom 54 of the trough by a piano hinge connection in which a pin 86 passes through the hinge. Pivotally connected to the side 81 of the dipper is the piston rod 87 of a hydraulic cylinder 88 and pivotally connected to the side 82 of the dipper is the piston rod 89 of a hydraulic cylinder 91. The opposite ends of the cylinders 88 and 91 are pivotally connected to the sides 57 and 56 of the trough.

Mounted on the underside of the bottom 83 of the dipper and secured thereto by any suitable means are a plurality of jack hammers, such as are well known in the art, and which are usually employed singly and manually for cutting pavements, cutting down ore and coal in mines, and in other excavating and breaking operations. No detailed description of these jack hammers is given. It is well known in the art that they include a rapidly reciprocating hammer element which acts upon suitable drills, or drill bits 97 to force them into the work. As shown in the drawing, the drill bits 97 extend outwardly from the material engaging lip 84 of the dipper so that material cut or broken down by the drill bits can pass readily into the dipper. As is also well known, the action of the reciprocating pistons and hammers in the jack hammers produce, in operation, a marked vibratory motion which is transmitted to the dipper and to the trough and which causes the trough to act as a vibrating conveyer to convey the material cut down to the rear of the trough.

As the operation of vibrating conveyers are well known in the art, no detail description is deemed necessary. However, to remove material cut or broken down while the trough slopes forwardly at an angle greater than the angle at which the vibrating conveyer will operate, the trough is raised by means of the hydraulic cylinder 63 until the trough slopes in the desired position. Also, to remove the material which falls to the bottom of the excavation, such as material cut or broken down while the dipper is in the operating position shown in Fig. 3, the material is scooped up by the dipper and the dipper is then raised as described above.

Mounted at the rear of the trough in position to receive material therefrom is a belt conveyer 100 which is supported from the side members of the vehicle frame by means of uprights 101 and conveyer frame members 102, only one of which is shown. Sprockets 103 and 104 are provided at the outer and inner ends, respectively, of the conveyer over which the conveyer belt runs. The conveyer may be driven by means of a motor 106 mounted on the frame of the vehicle. The conveyer 100 delivers the material from the apparatus to any suitable place such as into a truck 107.

Referring to Fig. 8, the hydraulic system is illustrated. At 108 is shown a liquid reservoir from which the liquid is pumped by a positive displacement pump 109 which delivers the liquid under pressure through conduits 110, 111, 112 and 113 to four-way valves 114, 116 and 118 respectively for operating the hydraulic cylinders heretofore described. Liquid under pressure flows from the valve 114 to the outer end of the cylinder 76 through a conduit 119 and simultaneously to the inner end of the cylinder 71 through a conduit 121. Fluid from the outer end of the cylinder 71 is returned to the valve 114 through a conduit 122 and from the inner end of the cylinder 76 through a conduit 123 which joins the conduit 122 and thence through the valve 114 through the conduit 115 and to the reservoir as already described. It will be understood that in the other position of the valve 114, fluid under pressure is supplied through the conduits 122 and 123 to the inner end of the cylinder 71 and the outer end of the cylinder 76, respectively, in which instance, the fluid is returned from the cylinder 71 and 76 through the conduits 121 and 119 to the valve 114 and thence to the conduit 115.

Fluid under pressure from the valve 116 is supplied to the inner end of the cylinder 63 through a conduit 120 and at the same time is returned to the reservoir 108 by means of a conduit 120*a* connected to the outer end of the cylinder and the valve 116 and a return conduit 120*b* which is connected to a common return conduit 124.

Fluid under pressure, as already described, passes to the valve 118 through the conduit 113 and from said valve passes simultaneously to the inner ends of the cylinders 88 and 91 through a conduit 126 and is returned to the reservoir 108 through a conduit 127 connected to the outer ends of the cylinders 88 and 91 and to the valve 118 from which it flows into the return conduit 124. Inasmuch as the cylinders 88 and 91 are connected to the sides of the dipper 80, the two cylinders act and move in unison.

In Fig. 9 the air supply conduit 128 leading to the jack hammers 92, 93, 94 and 96 is indicated diagrammatically. Air for the operation of said hammers is supplied through valve 129 in a manner well understood.

From the foregoing description the operation of my improved excavating apparatus will be readily understood. In the several views, particularly Figs. 1, 3 and 4, the apparatus is illustrated as it would preferably be employed in mining ore or coal. The vehicle, being self-propelled by means of the motors 14 and 16, is positioned before the face of the material to be excavated which is engaged by the dipper 80 and by the projecting drill bits 97. When breaking

down material, the dipper 80 and trough 50 may be operated in a normal position, that is, with the open side of the trough upwards, in which case the material broken down by the jack hammers and drills will fall directly into the trough and be conveyed rearwardly by vibration of the trough. If necessary, the trough 50 may be raised so that its outer end is above the level of the inner end in order to hasten the movement of the rearward movement of the material. If required to break down material over a wide arc, the trough 50 may be turned on its side as shown in Fig. 3 of the drawing, whereupon an arc may be cut which is somewhat wider than the vehicle. In event a large rock is broken down or falls down, as shown in Fig. 4, the position of the trough 50 may be wholly inverted, by rotating the inner ring 33 as previously described and bringing the jack hammers and drills to bear downwardly on the rock. The breaking action of the drills is greatly aided by the weight of the dipper and the trough. After the material is broken to the required size for loading, it may be loaded by turning the dipper to the position shown in Fig. 1 and manipulating it by means of the hydraulic cylinders as heretofore described. The feature of having the horizontal pivot of the trough 50 below the center of the ring 33 also aids in the breaking action just described in that it raises the inner end of the trough 50 to its highest point. It is further of advantage in that it lowers the inner end of the trough 50 when in its normal position and thereby greatly aids in conveying the material which has been broken down.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In excavating apparatus including a dipper with longitudinally reciprocating percussive cutting tools mounted thereon and projecting in advance of the engaging lip of the dipper, a vehicle, a trough at one end of which the dipper is hingedly mounted to discharge material thereinto, a yoke mounted at the forward end of the vehicle in which the trough is pivotally mounted at its opposite end, a rotary member in which the yoke is pivotally mounted transversely of the mounting of the trough, means to rotate said member in a substantially vertical plane, and means to move said trough and said yoke angularly of their pivotal mountings.

2. In excavating apparatus including a dipper with longitudinally reciprocating percussive cutting tools mounted thereon and projecting in advance of the engaging lip of the dipper, a vehicle, a trough at one end of which the dipper is hingedly mounted to discharge material thereinto, a yoke mounted at the forward end of the vehicle in which the trough is pivotally mounted at its opposite end, a rotary member in which the yoke is pivotally mounted transversely of the mounting of the trough, means to rotate said member in a substantially vertical plane, means to move said trough and said yoke angularly of their pivotal mountings, and means to vary the position of said dipper angularly with respect to the trough.

3. In excavating apparatus including a dipper with longitudinally reciprocating percussive cutting tools mounted thereon and projecting in advance of the engaging lip of the dipper, a vehicle, a trough at one end of which the dipper is hingedly mounted to discharge material thereinto, a yoke mounted at the forward end of the vehicle in which the trough is pivotally mounted at its opposite end, a rotary member in which the yoke is pivotally mounted, reversible means to rotate said rotary member in a substantially vertical plane, and means to move said trough and said yoke angularly of their pivotal mountings.

4. In excavating apparatus including a dipper with longitudinally reciprocating percussive cutting tools mounted thereon and projecting in advance of the engaging lip of the dipper, a trough at one end of which the dipper is hingedly mounted to discharge material thereinto, a self-propelled vehicle, a stationary ring fixedly mounted at the front of the vehicle and extending upwardly therefrom with the axis of the ring in a horizontal plane, a second ring mounted to rotate within the stationary ring, a yoke mounted to pivot about a vertical axis within the rotary ring, a horizontal pivotal mounting in the yoke for the other end of the trough, means to move the trough angularly in the yoke, means to move the yoke angularly with respect to the second ring and means to rotate said second ring.

5. Apparatus as defined in claim 4 in which the pivot for the trough is located below the center of the rotary ring.

6. In excavating apparatus, a vehicle, a stationary outer ring mounted on the front of the vehicle to stand vertically and transversely thereof, double beveled bearing seats formed on the inner face of the ring, an inner ring mounted to rotate within the outer ring and having double beveled bearing seats on its outer surface, double conical bearings between the rings, means to rotate the inner ring, a trough extending forwardly from the vehicle and having its rear end pivoted to swing horizontally and vertically within the inner ring, means to swing the trough, a dipper hingedly mounted on the outer end of the trough, means to vary the position of the dipper about its hinge point, and a plurality of vibrating percussive cutting tools mounted on the dipper and projecting forwardly from the engaging edge thereof.

7. Apparatus as defined in claim 6 in which the horizontal pivot of the trough is below the center of the inner ring when the open side of the trough is upwards.

8. Apparatus as defined in claim 7 in which a conveyer is mounted on the vehicle at the rear of the trough in position to receive excavated material therefrom.

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