July 4, 1944. N. D. LEVIN 2,353,052

LOADING MACHINE

Original Filed Oct. 22, 1937 6 Sheets-Sheet 1

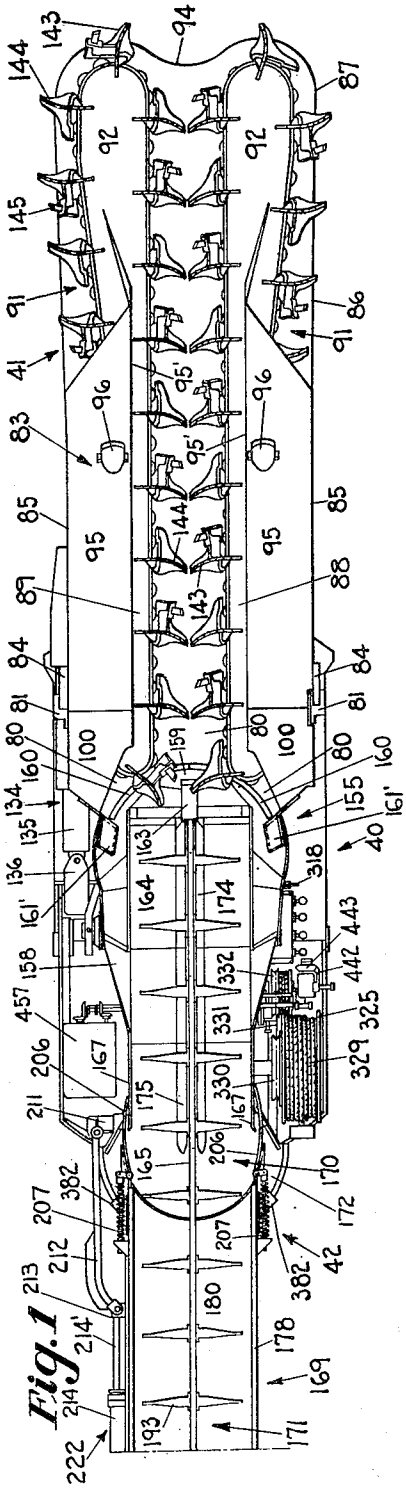


Fig. 1

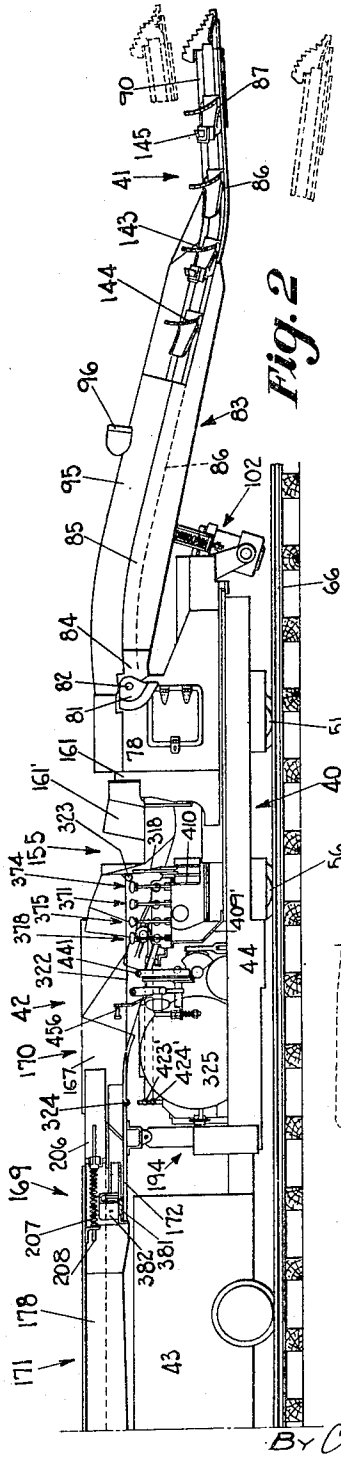


Fig. 2

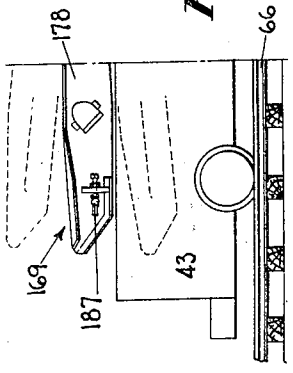


Fig. 3

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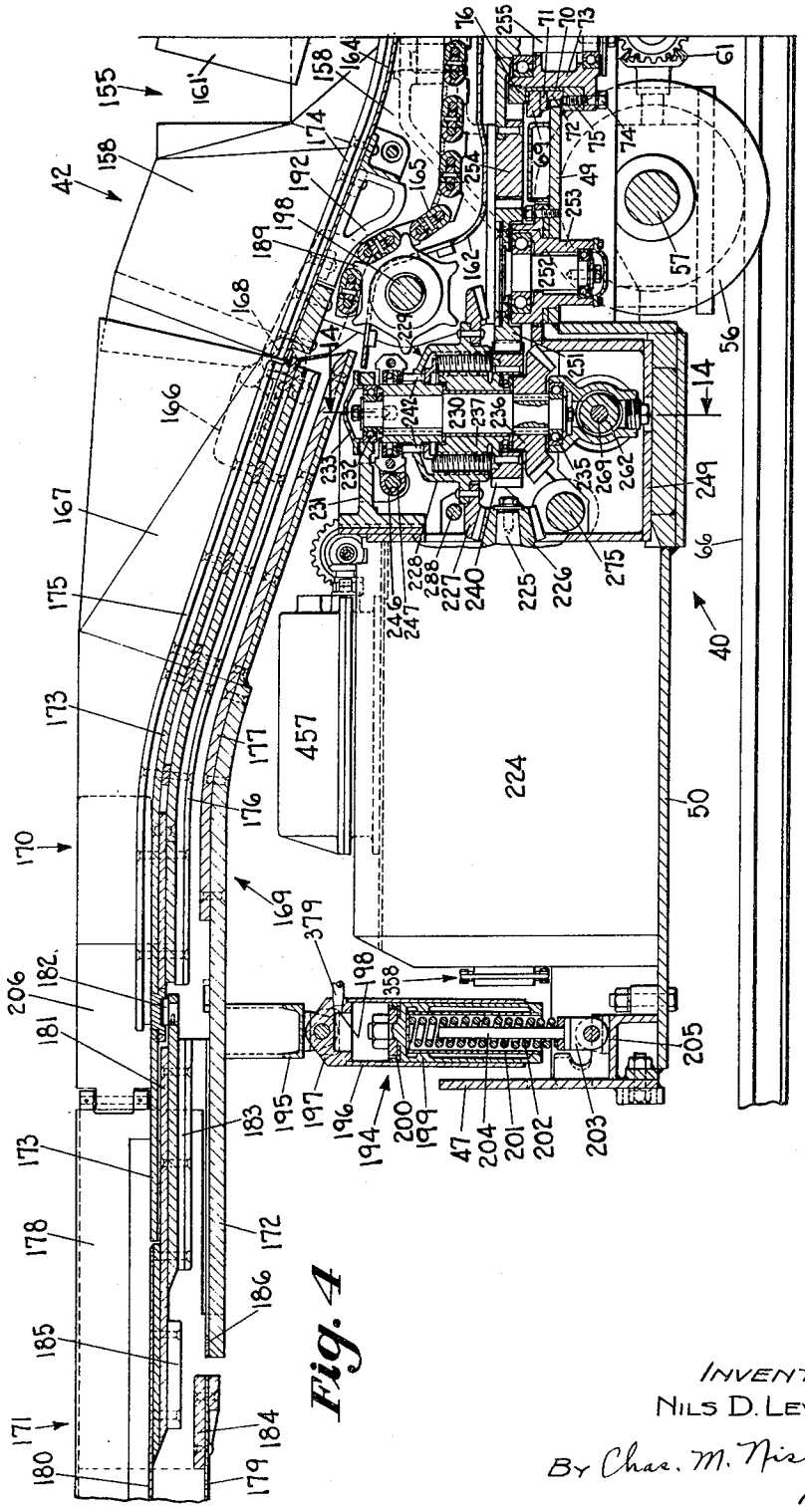


Fig. 4

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LOADING MACHINE

Original Filed Oct. 22, 1937 6 Sheets-Sheet 3

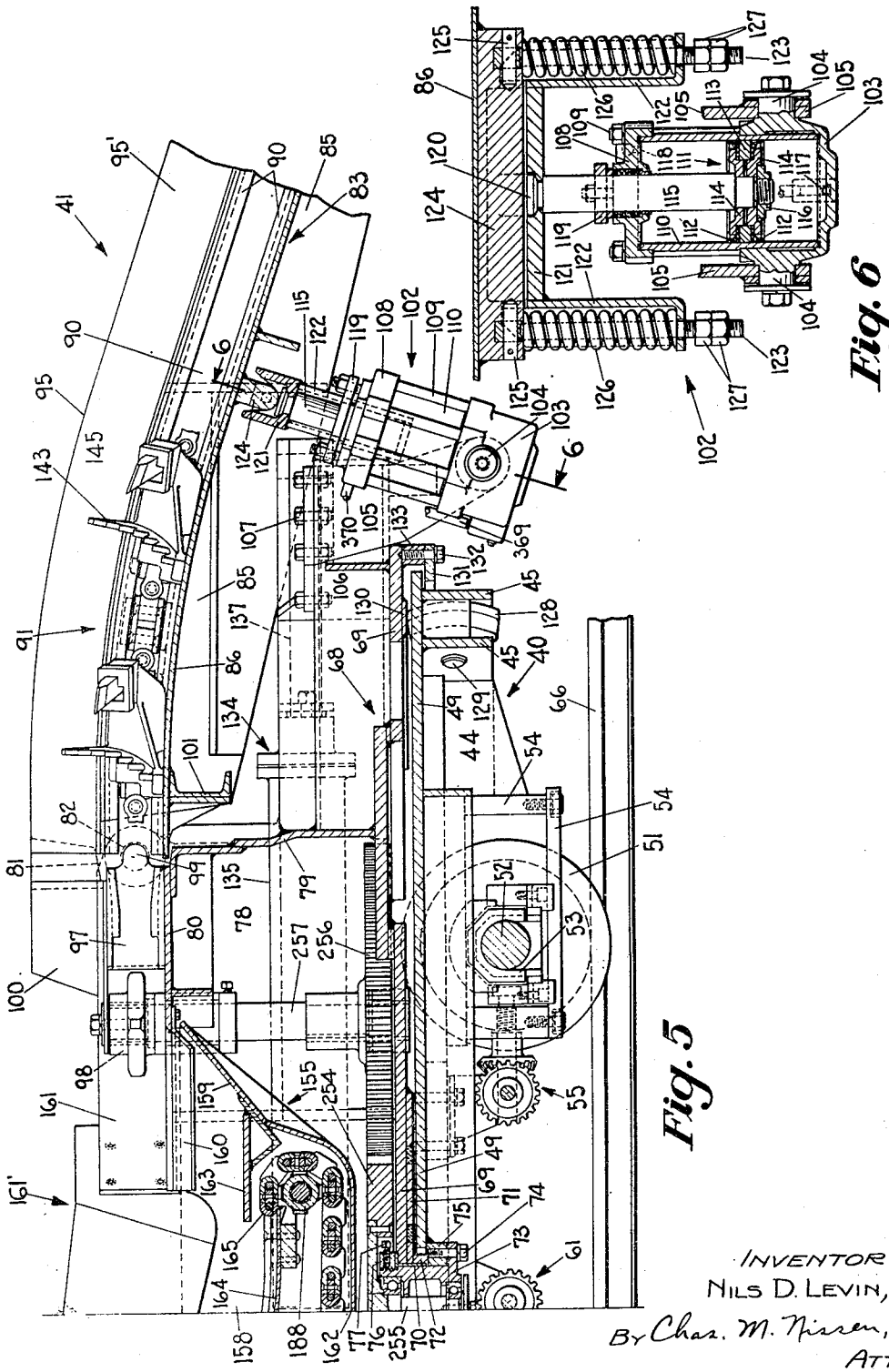


Fig. 5

Fig. 6

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Original Filed Oct. 22, 1937 6 Sheets-Sheet 4

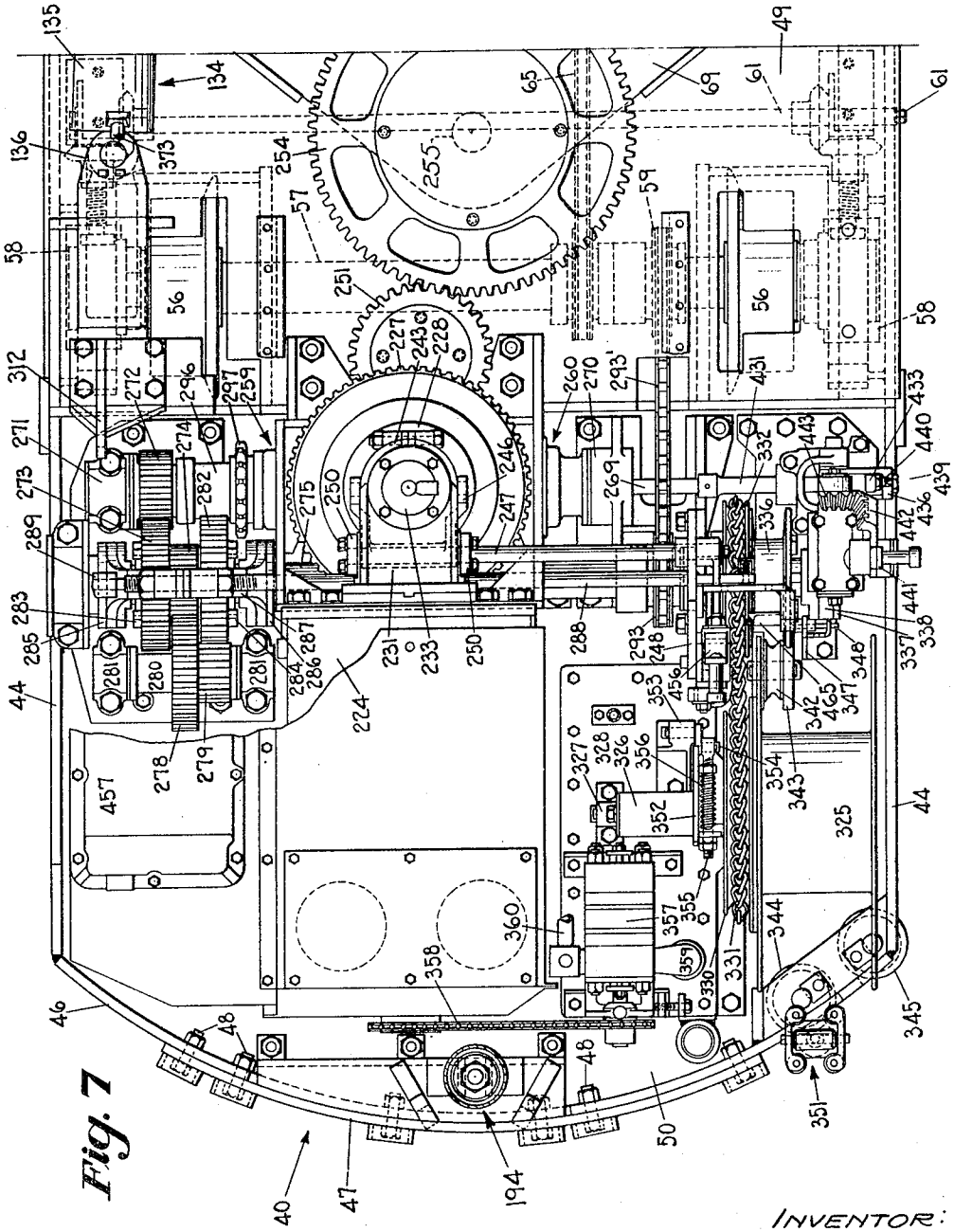


Fig. 7

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LOADING MACHINE

Original Filed Oct. 22, 1937 6 Sheets-Sheet 5

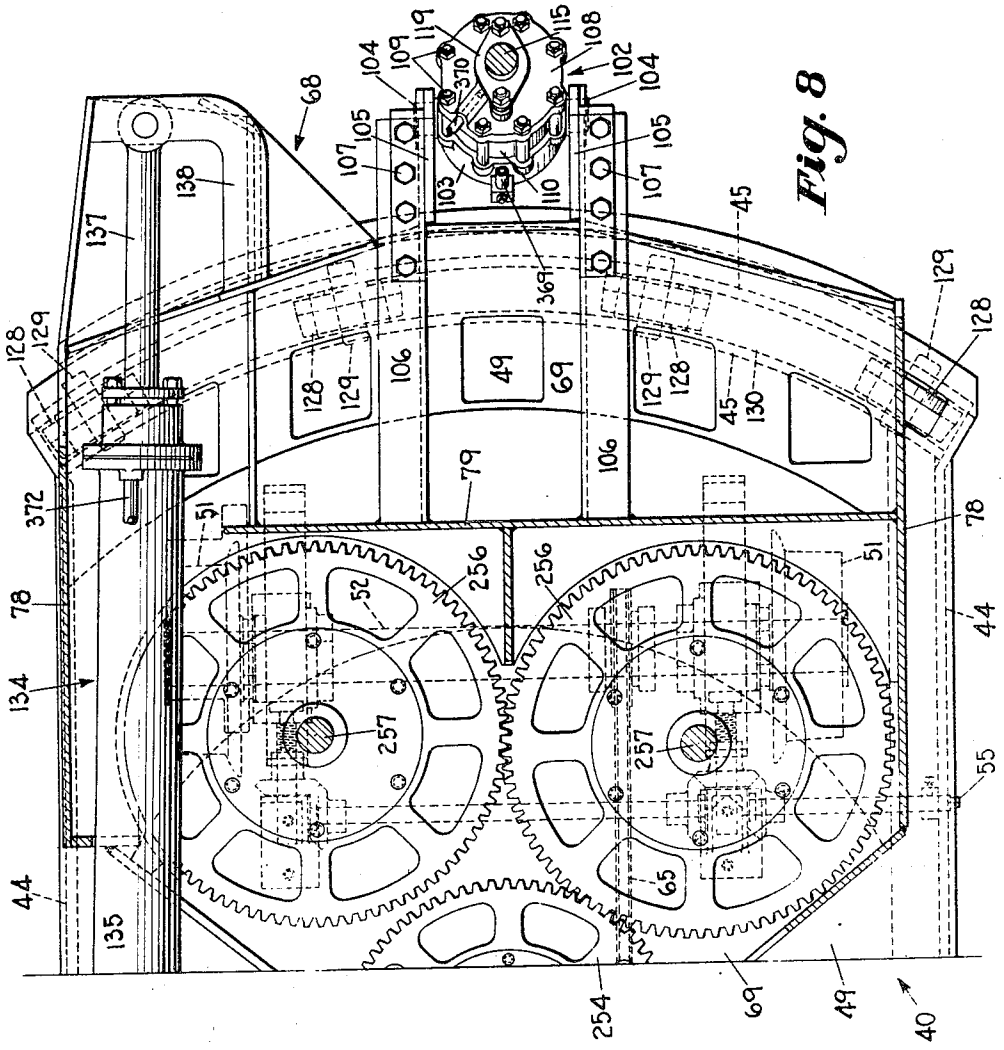


Fig. 8

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LOADING MACHINE

Original Filed Oct. 22, 1937 6 Sheets-Sheet 6

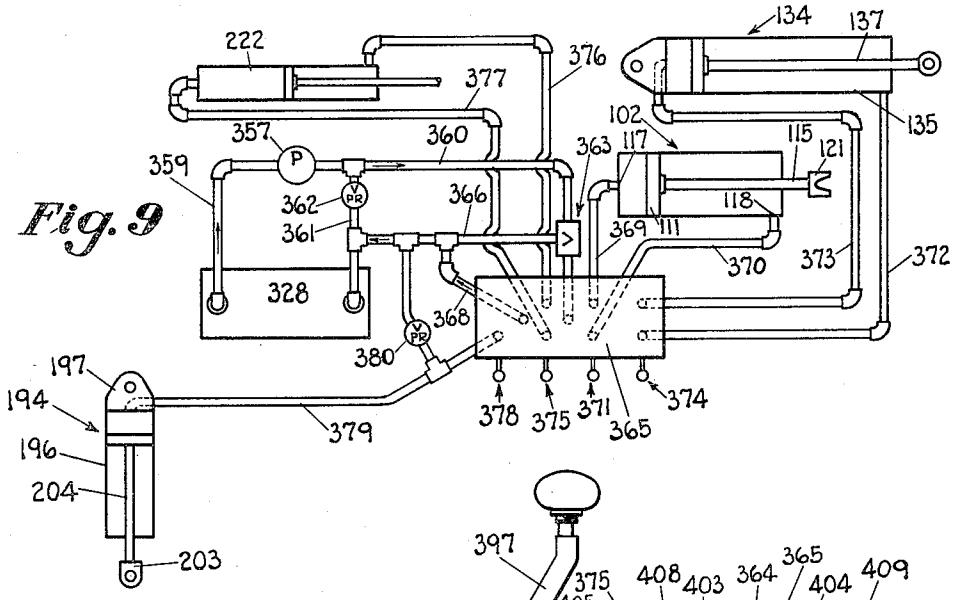


Fig. 9

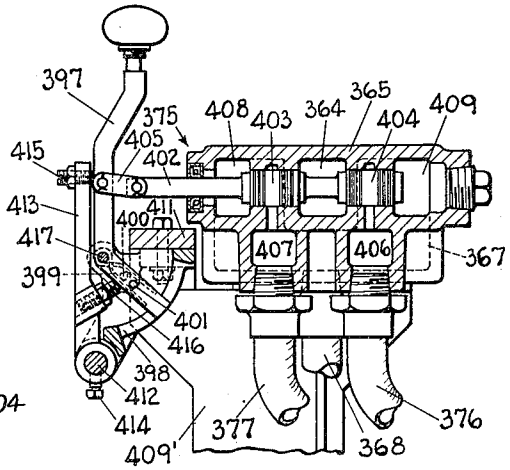


Fig. 10

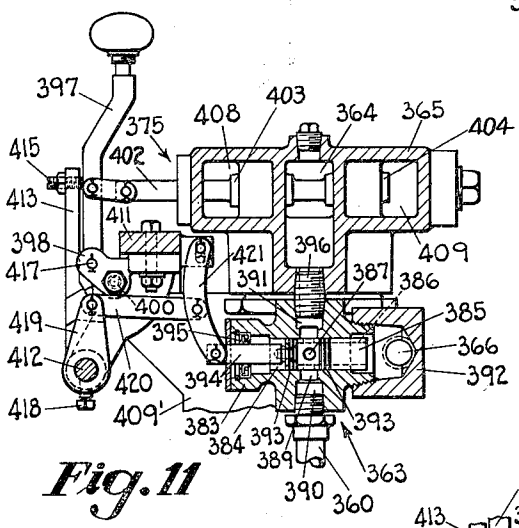


Fig. 11

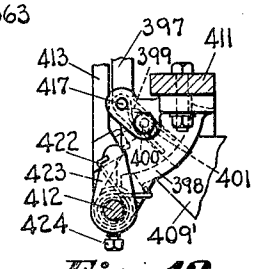


Fig. 12

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Patented July 4, 1944 2,353,052

UNITED STATES PATENT OFFICE

2,353,052

LOADING MACHINE

Nils D. Levin, Columbus, Ohio, assignor to The Jeffrey Manufacturing Company, a corporation of Ohio

Original application October 22, 1937, Serial No. 170,426. Divided and this application February 18, 1941, Serial No. 379,475

6 Claims. (Cl. 198—11)

This invention relates to loading machines, and one of the objects of the invention is the provision of an improved and efficient frontal attack type of loading machine adapted for the loading of coal in a coal mine particularly while still standing in a semi-compact mass at the coal face after having been shattered or dislodged from the solid of the mine vein by blasting charges.

A further object of the invention is the provision of an improved hydraulic control system particularly useful in loading machines.

Another object of the invention is to provide improved means for flexibly supporting gathering and discharge conveyors of a loading machine.

Still another object of the invention is to provide improved and efficient means for replacing upon a mine track the front wheels of a wheeled truck of a loading machine.

More particularly it is the object of the present invention to provide improved hydraulic mechanism for adjusting the elevation of a conveyor swingable on a horizontal axis and resiliently supporting such conveyor when in adjusted position.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

Fig. 1 is a plan view of the loading machine embodying my improvements, with the swinging boom of the discharge conveyor cut short;

Figs. 2 and 3 placed end to end constitute a side elevational view of the loading machine shown in plan in Fig. 1;

Fig. 4 is a vertical longitudinal sectional view of the rear end portion of the loading machine shown in Figs. 1 and 2;

Fig. 5 is a vertical longitudinal sectional view of the front portion of the loading machine shown in Figs. 1 and 2, with the extreme forward end of the gathering conveyor unit cut short;

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 5 looking in the direction of the arrows;

Fig. 7 is a sectional plan view showing particularly the rear end portion of the truck and the truck propelling means;

Fig. 8 is a continuation of Fig. 7, showing the forward end of the truck and the drive means for the gathering conveyor;

Fig. 9 is a piping diagram of the hydraulic system for the loading machine; and

Figs. 10, 11 and 12 show details of the valve mechanism.

This application is a division of my co-pending application, Serial No. 170,426, filed October 22, 1937, for an improvement in a Loading machine.

As illustrated generally in Figs. 1, 2 and 3 of the drawings, the mining and loading machine comprising my invention is primarily a frontal attack machine but provision is made whereby a gathering conveyor cannot become wedged into the material being loaded in that the attack is not confined to a front attack but also includes a lateral attack at both sides of the forward end of the gathering conveyor.

The said loading machine comprises a track mounted truck 40 upon which is mounted a gathering conveyor 41 and a discharge conveyor 42, the former being adapted to dig into and gather loose or semi-compact coal and to convey it to the latter by which it is discharged into track mounted coal cars, one of which is illustrated at 43. (Figs. 2 and 3.)

Power means is provided to tram the loading machine along the mine tracks at a relatively fast speed, and to operate it along said tracks at a feeding or operating speed while at the same time operating the gathering and discharge conveyors to gather and load coal into coal cars 43.

As best seen by reference to Figs. 2, 4, 5, 7, and 8, the truck 40 comprises a main frame formed by longitudinally extending side members 44 rigidly attached together at their forward ends by an arcuate front cross-piece formed by spaced members 45, preferably welded to the side members 44 and rigidly attached at their rear ends, as by welding, to an arcuate cross-piece 46 (Fig. 7) having removably attached thereto an arcuate bumper plate 47 held in place by nuts and bolts 48.

Adjacent its forward end, the main frame comprises a bed plate 49 (Fig. 5) rigidly attached to the tops of the side members 44 and front cross-pieces 45, as by welding. The gathering conveyor 41 and the drive means therefor are supported from this bed plate 49, as will be hereinafter explained in complete detail.

Adjacent its rear end the main frame is provided with a bed plate 50 (Figs. 4 and 7) which is rigidly attached to the bottoms of the side members 44 and the rear cross-piece 46. The bed plate 50 supports the single drive motor 224 which drives all of the apparatus on the loading machine, as hereinafter described in full detail, and supports most of the gear mechanism for controlling said loading machine.

As best seen in Figs. 4 and 5 of the drawings, the truck 40 is mounted upon a pair of forward track engaging flanged wheels 51, 51 keyed on

axle 52 which is journaled in adjustable bearing boxes 53, 53 slidably supported upon guideways 54, 54. Gearing mechanism 55 is provided for adjusting the bearing boxes 53, 53 in unison longitudinally along the guideways 54, 54 from a convenient position adjacent the side of the truck 40, as illustrated in Fig. 8.

The truck 40 is also provided with rearward track engaging flanged wheels 56, 56 mounted upon axle 57 journaled in bearing boxes 58, 58 (see Fig. 7) slidable longitudinally in guideways. Gearing mechanism 61 readily accessible from the side of the truck 40, as best seen in Fig. 7, is provided for adjusting the bearing boxes 58, 58 longitudinally in unison along guideways.

As clearly seen in Fig. 7 of the drawings, the gearing mechanism 61 includes a square headed shaft adapted to receive a crank, which square head may be locked in position by a latch slidable vertically in a guide and having a square notch at its lower end fitting over a squared portion of the shaft 61. Similar latch mechanism may be associated with the operating shaft of the gearing mechanism 55.

The axles 52 and 57 are provided with sprockets which are connected together by a continuous chain 65 to insure their movement in unison. Axle 57 also carries a drive sprocket 59 by which it is driven, as hereinafter described in full detail. It is thus evident that driving power will be applied to all of the track engaging wheels 51, 51 and 56, 56.

It is to be particularly noted, that the bearing boxes 58, 58 (Fig. 7) associated with axle 57 are positioned outside the wheels 56. As was previously mentioned, the bearing boxes 53, 53 associated with axle 52 are inside the wheels 51, 51. As a consequence, there is a modified three point suspension provided for the truck 40 which I have found allows all of the wheels 51, 51 and 56, 56 to remain on the mine rails 66 though the latter may be very uneven. This tends to prevent derailment of the machine.

It will be evident that the gearing mechanisms 55 and 61 may be employed to shift the axles 52 and 57 (Figs. 7 and 8) forwardly or rearwardly either to tension the chain 65 or to tension the drive chain associated with the sprocket 59.

The construction of the gathering conveyor 41 is best seen by reference to Figs. 1, 2, 4, 5, 7 and 8 of the drawings and comprises a turntable 68 formed by a bottom plate 69 provided at its rear end with a circular opening adapted to receive a journal bearing 70 (see Figs. 4 and 5) which is reinforced by a plate 71 and a ring 72, all rigidly attached together, as by welding. The journal bearing 70 is journaled to a casing 73 which is removably attached to the front bed plate 49 by virtue of screws 74 which thread into a ring 75 welded to the bottom of said front bed plate 49, as clearly seen in Figs. 4 and 5 of the drawings. It is thus evident that the turntable 68 is journaled to the truck 40 about an upright axis provided by the casting 73 thereby providing for lateral swinging movement of the gathering conveyor 41.

It will be evident that the thrusts received by the gathering conveyor 41 will be translated to the truck 40 through the casting 73 and thus this casting and the journal bearing 70 associated therewith is made of very rugged construction.

As clearly illustrated in Figs. 4 and 5 of the drawings, the bottom plate 69 is removably attached to the casting 73 by a threaded ring 76 threaded to the top of said casting 73 and held locked by a set screw 77.

The turntable 68 also includes upright side plates 78 and intermediate front plates 79 which cooperate to support a top plate 80, which plates co-operate to provide a gearing housing and support, as hereinafter explained in full detail.

As best seen in Figs. 1 and 2 of the drawings, side plates 78 of the turntable 68 carry side brackets 81, 81 provided with pivot pins 82 upon which is pivoted the gathering boom 83 of the gathering conveyor 41 by means of brackets 84, 84 (Fig. 1) having apertures to receive the pins 82, which brackets 84, 84 are welded rigid with side members 85, 85 of said gathering boom 83. It will be evident that the boom 83 is swingable with respect to the turntable 68 about a horizontal axis provided by the pivot pins 82. The gathering boom 83 comprises a bottom plate 86 welded to a cross I-beam 101 (Fig. 5) which said bottom plate 86 is welded rigid with the side members 85, 85 and, at its rear end, is substantially parallel with and forms an extension of the top plate 80 of turntable 68.

As clearly illustrated in Fig. 2 of the drawings, the bottom plate 86 is provided with a flat working portion 87 adjacent its forward end which lies in a plane forming an angle with the plane of the major portion of said bottom plate 86, said two plates being connected by a smooth curve. In other words, the bottom plate 86 is smoothly curved to form a working portion 87 at its forward end which is substantially horizontal thereof when at the mine floor, slightly sloping upwardly and rearwardly when the boom 83 is in its lowered position with the working portion 87 sliding over the floor of the mine. This construction is particularly desirable to the end that the bottom plate 86 may work under all of the coal during the attack on the shot-down or semi-compact mass of coal.

As best illustrated in Fig. 1 of the drawings, the bottom plate 86 carries a pair of gathering chain guides 88 and 89 each formed by an outer grooved track member 90 grooved at its outer surface to receive the side bars and retaining gibs of the gathering conveyor chains designated generally 91, 91. That is, the track members 90 are provided with grooves and retaining flanges to keep the gathering conveyor chains 91, 91 in proper position. Cover plates 92, 92 extend between the opposite sides of each track member 90 to prevent any material accumulating therebetween. Reinforcing bars are provided inside each of the track members 90 and all of said members comprising bottom plate 86, track members 90, 90, cover plates 92 and reinforcing bars are rigidly attached together by appropriate rivets.

As clearly illustrated in Fig. 1 of the drawings, the track members 90 extend substantially the full length of the gathering conveyor 41 and thus the gathering conveyor chains operate substantially through the entire length of said gathering conveyor. As a consequence, there is only one re-handling of the gathered material from the time it is first gathered by the gathering conveyor to the time it is discharge into the mine cars and this is during the time it is discharged from the gathering conveyor to the discharge conveyor.

It is furthermore to be noted by particular reference to Fig. 1, that the inner portions of the track members 90 are substantially parallel through the entire length. As a consequence,

there is no progressive squeezing action on the coal being loaded which can produce undesirable stresses and strains.

As was previously pointed out, the width of the bottom plate 86 is substantially constant throughout its entire length but at the front end attacking portion thereof it is curved rearwardly as seen at 94 (Fig. 1) to provide for a maximum amount of contact of the flights of the gathering conveyor chains during operation.

It is also to be particularly noted that during the rearward portion of the travel of the conveyor chains 91 in their progress toward the front end of the gathering conveyor, the flights are spaced inwardly of the sides of the bottom plate 86 and are within the confines of the side members 85 which are provided with appropriate cover plates 95, 95 (see Fig. 1) attached to inner side wall cover plates 95', 95' (see Figs. 1 and 5). However, adjacent the forward end of the gathering conveyor 41 the cover plates 95 and 95' and the side members 85 are removed and the track members 90 diverge progressively as the front end is approached. As a consequence, the flights of the gathering conveyor chains 91 progressively move laterally beyond the edges of the bottom plate 86 adjacent the flat working portion 87 thereof. These flights also, in moving around the front curved ends of the guide members 90, extend beyond the front extremity of the curved portion 94 of the bottom plate 86 to dig into, break down and gather the coal either in shot-down condition or in a semi-compact mass. This operation is described in more complete detail hereinafter.

As clearly illustrated in Fig. 1 of the drawings, I also preferably provide a pair of electric lights 96, 96 on the gathering conveyor 41 to illuminate the material being worked.

Since the gathering boom 83 of the gathering conveyor 41 is pivoted about a horizontal axis 82 with respect to the turntable 68 of said gathering conveyor 41, it is, of course, evident that the track members 90 must be broken at this pivot point. As illustrated in Fig. 5 of the drawings, an extension for the track members 90 is provided at 97 to guide the conveyor chain 91 in its movement over the turntable 68. The extensions 97, of which there will be one for each of the two gathering conveyor chains, provide guide paths on each side thereof leading both to and from drive sprockets 98 for which there will be one for each of the chains 91, 91. The extensions 97 will, of course, terminate the guide track for the chains 91, 91 adjacent the drive sprockets 98, 98.

Each of said extensions 97, 97 is provided with a rounded nose 99 (Fig. 5) adapted to extend into a pocket in the frame of the boom 83 and slightly spaced therefrom. This, of course, permits limited movement of the boom 83 about the horizontal axis provided by the pins 82, 82. It is also to be noted that protecting cover plates 100 are provided adjacent and above the top plate 80 of the turntable 68, which cover plates 100 overlap the cover plates 95. (Fig. 5.)

To provide for the vertical swinging movement of the boom 83 about the axis of pivot pins 82 I provide a double acting type of hydraulic piston motor mechanism best seen in Figs. 5, 6 and 8 of the drawings and designated generally by the reference number 102. Said piston motor mechanism 102 comprises a bottom head casing 103 provided with trunnions 104 by which it is pivotally mounted upon a bracket formed by spaced plates 105, 105 rigidly but removably attached to frame members 106, 106 of the turntable 68 by nuts and bolts 107, 107.

Clamped rigidly between the head casting 103 and a piston rod receiving cylindrical head 108 by a plurality of elongated clamp bolts 109, provided with appropriate nuts, is a cylinder 110. Within the cylinder 110 is a piston 111 formed by a pair of opposed sealing rings 112, 112 preferably made of leather or a composition to effect a perfect seal and carried upon a ring 113 and clamped between clamp plates 114 clamped rigidly to a piston rod 115 by a keyed nut 116. The head casting 103 is provided with an inlet port 117 and the cylinder head 108 is provided with an inlet port 118. The piston rod 115 extends through an appropriate opening in the cylinder head 108 provided with an appropriate packing gland or stuffing box 119. It will be evident that fluid under pressure may be admitted either above or below the piston 111 to move it either upwardly or downwardly.

As hereinafter described in complete detail, the piston 111 may also be sealed and locked in any adjusted position. The upper end of the piston rod 115 is provided with an upset head 120 received fixedly but loosely in a channeled cross member 121 provided at its opposite ends with downwardly extending L-shaped hanger plates 122, 122 forming a yoke. The connection between the head 120 and the cross member 121 permits relative movement between them while insuring their attachment together.

The hanger plates 122, 122 have their horizontal portions provided with apertures through which extend rods 123, 123 pivotally attached at their tops by pins 125, 125 to a transversely extending bar 124 welded rigidly with the bottom plate 86 of the boom 83. Between the horizontal portions of said hanger plates 122, 122 and said bar 124 and surrounding the rods 123, 123, I provide compression coil springs 126, 126. The bottom ends of the rods 123, 123 are threaded and receive adjusting and lock nuts 127, 127.

It will be evident, particularly by reference to Fig. 6 of the drawings, that the boom 83 is supported upon the coil springs 126, 126. When the loading machine, with the gathering conveyor 41 elevated, travels along the track about the same weight is carried on each of the axles 52 and 57. When at the face, the front end of the gathering conveyor 41 is lowered until it rests on the mine floor. This takes a great amount of weight off the front axle and, except for springs 126, 126, would throw the machine out of balance to such an extent that the front wheels 51, 51 might raise off the track and derail the machine. Also, sometimes the front end of the gathering conveyor 41 climbs up a roll in the mine bottom. The springs 126, 126 insure sufficient load on front wheels 51, 51 to keep them on the track rails under all normal conditions and prevent derailment.

By reference particularly to Figs. 5 and 8 of the drawings, it will be seen that adjacent the front end of the truck 40 and extending upwardly through the front bed plate 49 thereof, is a plurality of rollers 128 mounted upon stub shafts 129 carried by the spaced plates of the front cross-piece 45. These rollers 128 bear against an arcuate bearing plate 130 carried on the bottom plate 69 of the turntable 68 and thus provide an anti-friction support for the front end of the turntable 68 of said truck 40. In other words, the turntable 68 will be support-

ed upon the truck 40 by the journal bearings 70 and by the rollers 128 and bearing plate 130.

To insure upward movement of the truck 40 in case the forward end of the gathering conveyor 41 is operated to return the front wheels 51 of the truck to the mine rails, I provide an arcuate lifting plate 131 (Fig. 5) which extends under the forward edge of the front bed plate 49 and is rigidly attached to the bottom plate 69 of the turntable 68 by screws 132 threaded in an arcuate spacer 133.

To provide for the swinging of the gathering conveyor 41 about the vertical axis of casting 73 I provide a very simple and compact arrangement in the form of a hydraulic piston motor 134, best seen in Figs. 7 and 8 of the drawings, comprising a cylinder 135, pivotally attached at its rear end to a bracket 136 formed rigid with the main frame of the truck 40, and a piston carrying a rod 137 pivotally attached to a bracket 138 formed rigid with the turntable 68 of the gathering conveyor 41. The piston motor 134 is of the double acting type. That is, it may be moved under power in reverse directions and with the system comprising my invention, may be locked in any adjusted position, as hereinafter described. It is to be noted that this hydraulic piston motor is entirely within the confines of the loading machine truck 40 and thus does not increase the width of said machine. It is furthermore to be noted that it is highly protected and therefore cannot be easily damaged.

Attention is now directed particularly to Figs. 1, 2 and 5, inclusive, and to the construction of the gathering conveyor chains 91 and the gathering flights which they carry. Each of said gathering chains 91 comprises a plurality of main links formed by spaced retaining gib carrying side bars interconnected with a plurality of connecting links formed in two parts which are pivotally connected about horizontal axes. The main links and connecting links are pivotally attached together by pins. The pins make a snug fit with the connecting parts whereby the chain will be relatively rigid except for movement about rectangularly disposed horizontal and upright axes provided by said pins. That is, each chain 91 will be free to pivot about a horizontal axis so the chain can travel over the irregular surface of the bottom plate 86, and also free to pivot about a vertical axis so the chain can travel around the continuous generally orbital path provided by the track members 90. For any other movement the chain will be relatively rigid which is particularly desired in carrying out the rather heavy work required of the gathering chains 91.

I pivotally attach to every sixth main link a gathering flight 143 interspersed with alternate gathering flights 144. The essential difference between the gathering flights 143 and 144 lies in the fact that the former carry removable bits or picks 145 which are particularly effective to dig into and break down a semi-compact mass of material while the gathering flights 144 are devoid of such bits or picks.

Attention is now directed particularly to the construction of the discharge conveyor 42 as illustrated in Figs. 1, 2, 3, and 4. Said discharge conveyor 42 comprises three articulated parts including a stationary hopper 155 supported upon the front bed plate 49 of the truck 40 by spaced side brackets. The hopper 155 comprises spaced side members 158 and a downwardly inclined rear chute 159 (Fig. 5) formed integral with said side plates 158. The chute 159 is adapted to receive coal as it discharges from the rear end of the gathering conveyor 41 over the top plate 80. A guiding arcuate apron 160 is carried by the top plate 80 in overlapping relation with the chute 159 to insure the proper reception of coal by said hopper 155 without any loss thereof. The chute 159 is of generally conical form thus permitting free rotation of the apron 160 with respect thereto.

It may also be pointed out that the side plates 73 of the turntable 68 have rearwardly extending deflector wings 161, 161' which extend over and partially into the arcuate chute 159 of the hopper 155 thus guiding the material discharged by the gathering conveyor 41 into the hopper 155. (Fig. 1.) The hopper 155 is provided with a chain guiding bottom plate 162 (see Figs. 4 and 5) which is primarily adapted to guide the return flight of the conveyor chain associated with the discharge conveyor 42. A feed plate 163 is provided adjacent the forward end of the chute 159 in the hopper 155 and feeds the material onto a material supporting false bottom plate 164 of the hopper 155 over which bottom plate 164 the upper run of the flight carrying conveyor chain 165 of the discharge conveyor 42 travels to convey the coal rearwardly and discharge it into the cars 43.

Pivotally attached to the hopper 155 by means of spaced side brackets 166, 166 (Fig. 4) carried by side members 167, 167 and journaled on pins 168, 168 is a discharge boom 169. It is evident that the boom 169 is pivoted about a horizontal axis formed by pins 168 for vertical swinging movement with respect to the hopper 155 and the truck 40. The discharge boom 169 is formed in two parts comprising the forward part 170 and the rearward part 171 which are pivotally attached about a vertical axis, the reaward part 171 being swingable horizontally about said vertical axis. The forward part 170 of the boom 169 comprises a bottom plate 172 (Fig. 4) which acts somewhat as a continuation of the bottom plate 162 of the hopper 155 (Figs. 4, 5).

Positioned above the bottom plate 172 is a material supporting false bottom plate 173 which forms a continuation of the material supporting false bottom plate 164 of the hopper 155. Extending successively along the false bottom plates 164 and 173 are a pair of spaced guiding and retaining angle members 174 and 175, respectively. As clearly illustrated in Figs. 1 and 4 of the drawings, these angle members 174 and 175 cooperate with retaining gibs on the conveyor chain 165 to retain it in place while permitting longitudinal movement thereof, at the same time guiding it properly along the center of the troughway formed by the false bottom and side plates of the discharge conveyor 42.

Extending downwardly from the false bottom plate 173 and in alignment with the angle members 174, 174, I provide angle members 176 which form a guide and support for the return flight of the chain 165 during its travel along the forward part 170 of discharge bottom 169. Opposite the angle members 176 and carried on top of the bottom plate 172 is a wear strip 177 which also aids to support the return strand of the chain 165.

As clearly indicated by reference to Figs. 1 to 4 of the drawings, the rearward part 171 of the discharge boom 169 comprises spaced side plates 178, 178 between which extends a bottom plate

179 above which is positioned a material supporting false bottom plate 180 which is a continuation of the false bottom plate 173 and over which the conveyor chain 165 travels and conveys the material. The forward end of the rearward part 171 has attached to the false bottom plate 180 contacting plate means 181 which is pivotally attached by a pivot 182 to the rear end of the false bottom plate 173.

As clearly illustrated in Fig. 1 of the drawings, the rear end of the false bottom plate 173 and of the bottom plate 172 are formed on the arc of a circle, the center of which is along the axis of the pivot 182. Likewise, the forward end of the bottom plate 179 and the false bottom plate 180 are formed on the arc of slightly larger circles than those of plates 172 and 173, respectively, whereby a continuous surface is provided in each case for any swinging position of the rearward part 171 of the discharge boom 169.

It is also to be noted by reference to Fig. 4 of the drawings, that angle members 183 are provided on the bottom of the plate member 181 to form a guide for the return strand of the chain 165 leading up to the pivot point provided by pivot 182.

Adjacent the break between the bottom plates 172 and 179 I provide a lower wear plate 184 on plate 179 and laterally spaced guide plates 185 on member 181. These plates 184 and 185 serve to guide and direct the return strand of the chain 165 so that their gibs enter the guideways of the angle members 183.

Adjacent the rearward arcuate end of the bottom plate 172 I provide an arcuate bearing plate 186 upon which rolls a pair of rollers 381 (see Fig. 2) carried at opposite sides of the front end of the rearward part 171 of discharge boom 169 by brackets 382, which, with the pivot 182, support the rear part 171 of the discharge boom 169. Adjacent its rearmost end the rearward part 171 will be provided with a centrally positioned discharge sprocket mounted upon an adjustable shaft 187 (see Fig. 3) upon which sprocket the conveyor chain 165 will ride. At the forward end of the discharge conveyor 42 (see Fig. 5) I provide within the hopper 155 a centrally disposed guide sprocket 188 for said chain 165.

To effect the driving of the discharge conveyor 165 I provide a drive sprocket 297 (Fig. 7) with an endless sprocket chain (not shown) and connect the same to a sprocket on the shaft 198 (Fig. 4) to which is keyed near the center thereof the sprocket 189 which meshes with the discharge conveyor chain 165. The sprocket 297 is connected to the shaft 262 to rotate therewith. Power transmission gearing connects the electric motor 224 to the shaft 262 so that whenever the motor 224 operates, the discharge conveyor will be driven.

As clearly illustrated in Figs. 2 and 4 of the drawings, the means for swinging the discharge boom 169 about the horizontal axis provided by the pins 168, comprises a single acting hydraulic piston motor mechanism 194 comprising a bracket 195 rigidly attached to the bottom of the bottom plate 172 to which is pivotally attached a cylinder 196 having a head 197 provided with an appropriate inlet port 198 within which cylinder extends a cylindrical piston 199 provided at its top with a clamped leather or compound sealing ring 200 which makes a leak-proof sliding fit, within which cylindrical piston 199 is a guide cylinder 201 within which extends a coil spring 202 mounted upon a pivoted coupling member 203 having an upstanding guide rod 204 which extends into the coil spring 202 and into the guide cylinder 201, the coupling member 203 being pivotally attached to a bracket 205 formed integral with the rear bed plate 50 and the bumper plate 47 of the truck 40.

It is evident that the coil springs 202 will provide a flexible support for the discharge boom 169 for any position of adjustment thereof, thus relieving any strain caused by a large lump of coal on the boom striking the top of the mine roof or for any other similar cause. The guire rod 204 provides a guide and retaining means for the coil spring 202.

It will be evident that by admitting fluid under pressure to the port 198 or discharging it by said port, the piston 199 may be adjusted in the cylinder 196 to expand or contract the hydraulic piston motor mechanism 194 thus swinging the discharge boom 169 about the horizontal axis provided by the pins 168. By locking the fluid in the cylinder 196, as hereinafter described, the boom 169 may be locked in any elevated position.

Attention is now directed particularly to the construction of the means for swinging the rearward part 171 of the discharge boom 169 with respect to the forward part 170 thereof. It may be mentioned that to provide continuous side walls for the discharge conveyor 42 for any position of adjustment of the rearward part 171 with respect to the forward part 170, each of the side plates 178 carries a pivoted arcuate extension side plate 206, (Figs. 1, 2) the free end of which is urged into contacting relation with the side plate 167 by a coil spring 207 coiled about an extensible rod 208 pivoted at one end to a bracket rigid with the plate 206 and extending through a bracket formed rigid with the side plate 178. As the rearward part 171 of the boom 169 swings about the axis of pin 182 (Fig. 4), the free end of the plate 206 will move forwardly and rearwardly in contacting relation with the side member 167 thus forming continuous sides for the discharge boom 42.

To cause swinging movement of the rearward part 171 of the boom 169, with respect to the forward part 170 thereof about the axis of pin 182, I provide a bracket 211 formed rigid with the bottom plate 172. Pivotally attached to bracket 211 is a rod 212 the rear end of which is pivoted to a sliding head 213 of a hydraulic piston motor 222. Said hydraulic piston motor 222 comprises a cylinder 214 rigidly attached to a side plate 178 of rearward part 171 of discharge boom 169 within which is a piston attached to a piston rod 214'.

It is evident that upon operation of the hydraulic piston motor 222 the rearward part 171 of discharge boom 169 will swing about the axis of pin 182 (Figs. 1, 2). The motor 222 may be locked in any desired position of adjustment to lock the rearward part 171 of discharge boom 169 in position. In actual pratice this angle of swing is made approximately eighty degrees. It may also be mentioned that the angle of swing of the gathering conveyor 41 is also approximately eighty degrees.

This ability to swing the discharge boom by fluid pressure motor operated mechanism provides for the loading of cars on tracks adjacent the track which supports the loading machine and, in addition, provides for the loading of cars while the loading machine is on a curved track. It is also useful in traveling around curves while tramming the loading machine to an operating position.

Attention is now directed particularly to Figs. 4, 5, 7 and 8 and to the drive means for the various devices to be driven. At the outset it may be stated that only a single or common electric motor **224** is relied upon as the primary source of power to effect a driving of all of the devices of the loading machine. Said electric motor **224** is mounted upon the rear bed plate **50** of the truck **40** and compactly positioned below the discharge conveyor **42** which extends upwardly and rearwardly from the hopper **155**. Due to this positioning of the electric motor **224** it is possible to provide a very large and powerful motor which is capable of effecting any and all of the drives required at any time while maintaining a machine of low height to permit its use in a relatively low head coal mine. Said electric motor **224** is provided with a forwardly extending armature shaft **225** (see Fig. 4) carrying a drive pinion **226** meshing with a bevel ring gear **227** which is rigidly attached to the housing **228** of a friction clutch mechanism **229** (see Fig. 4). The housing **228** is keyed to a vertical shaft **230** which is mounted at its top in a bracket **231** rigidly attached to the main frame of the truck **40**, there being an anti-friction ball bearing **232** interposed between the bracket **231** and the shaft **230** which is held in place by a removable cap **233**. The bottom of the shaft **230** is supported in a bracket formed rigid with the bottom plate **50**, said support being through an anti-friction ball bearing **235**. Keyed to the lower end of the shaft **230** and above the bearing **235**, is a bevel gear **236**. It may thus be noted that the gear **227** and the gear **236** being both keyed to the shaft **230**, will be driven together at all times from the motor **224**.

Journaled loosely on the central portion of the shaft **230** is a clutch member **237** (Fig. 4). Splined on the interior of the housing **228** and on the exterior of the clutch member **237**, which members **228** and **237** comprise cooperating clutch members, is a plurality of overlapping stacked friction plates, alternate ones of which are connected to the housing **228** and the clutch member **237**, respectively. Adjacent its bottom the clutch member **237** is provided with an integral extended flange to which is pinned a gear **240**. The flange, in addition to supporting the gear **240**, also acts as one compression member for the friction clutch plates **238**.

To effect a compression of the clutch plates **238** and thus to effect an engagement of the clutch elements **228** and **237**, I provide a compression ring within the housing **228** having a flange which bears against said plates **238**. Downward movement of the ring to effect the aforementioned compressing action is effected by a plurality of pins **242** which extend through apertures in the housing **228** and are carried by a ring operable through an anti-friction ball bearing operable by a trunnion collar which is controlled by a shipper **246** keyed on a shaft **247** (Fig. 4) which shaft **247** is journaled at one end in an upwardly extending plate **248** (Fig. 7) rigidly attached to a false bottom plate which, in turn, is rigidly attached to the main frame of the truck **40**, as clearly illustrated in Fig. 4 of the drawings.

Adjacent its other end the shaft **247** is supported in a pair of downwardly extending apertured plates **250, 250** (see Fig. 7) which are bolted to the bracket **231**.

It will be evident that rocking movement of the shaft **247** to urge the collar downward will cause an application of the friction clutch **229** to drive the gear **240** and when the shaft **247** is released the clutch **229** will automatically become disengaged due to lack of sufficient clamping pressure on the plates **238**.

It may be stated that the gear **240** which is controlled by the clutch **229** is individual to a gear train for driving the gathering conveyor chains **91**. This gear train will now be described with particular reference to Figs. 4, 5, 7 and 8. The gear **240** meshes with idler gear **251** mounted upon an anti-friction supported shaft **252** journaled in a cup **253** rigidly and removably attached to front bed plate **49**, which gear **251** in turn meshes with a large gear **254** carried by a shaft **255** on anti-friction bearings in the previously described casting **73**. (Fig. 4.)

It is to be particularly noted that since the vertical axis about which the gathering conveyor **41** swings is along the axis of the shaft **255**, power can be transmitted to said gathering conveyor through the gear **254** while the gathering conveyor is in any desired position of adjustment. The large gear **254** meshes with one of a pair of intermeshing large gears **256, 256** (Figs. 5 and 8) which are journaled in the bottom plate **69** and top plate **80** of the turntable **68** and which drive the previously mentioned sprockets **98, 98** through shafts **257, 257**. It is thus seen that the two drive sprockets **98** are driven in reverse directions and at the same speeds, thereby to drive the gathering chains **91, 91** at the same speeds and in reverse directions, with the flights on one chain in fixed relation to the flights on the other chain.

Attention is now directed particularly to Figs. 4 and 7 and to the gear train which is operative to drive the truck **40** either forwardly or reversely and at either a fast tramming or transportation speed or at a low feeding or sumping speed. This gear train includes the previously described gear **236** which, as above pointed out, is driven directly from the motor **224**. Gear **236** meshes on opposite sides with bevel gears of reversing friction clutches.

The reverse ends of the shaft **262** are mounted in appropriate journal bearings **270** and **271** both formed rigid with the false bottom plate **249** (Figs. 4 and 7).

Keyed to the shaft **262** is a drive pinion **272** which, as best seen in Fig. 7, drives a variable speed reduction mechanism comprising a gear **273** constantly in mesh therewith, which is keyed to a pinion **274** both of which are journaled loosely upon a countershaft **275**. Pinion **274** meshes with a larger gear **278** keyed to a pinion **279** and mounted upon a shaft **280** (Fig. 7) journaled in bearings **281, 281**. Pinion **279** meshes with a gear **282** which is also loosely journaled on countershaft **275**.

The gears **273** and **282** are provided with clutch jaws **283** and **284** respectively, which cooperate with clutching elements **285** and **286**, respectively, having appropriate cooperating jaws. A shipper **287** is provided for the clutching elements **285** and **286**, which shipper is adjustably mounted on a shiftable shaft **288** slidable at one end in a journal **289** carried by side plate **44** and at the other end pivoted to an operating lever.

In the position illustrated in Fig. 7 of the drawings, both of the clutching elements **285** and **286** are in clutch disengaging position and thus no drive whatever will be effected to the countershaft **275**. If the shaft **288** is moved in one direction, clutching element **285** will be moved to engaged position which will effect a high speed connection between the drive shaft **262** and the

countershaft 275. When the clutching element 286 is moved into engaged position by moving the shaft 288 in the other direction, a low speed connection will be effected between the drive shaft 262 and the countershaft 275.

Keyed to the countershaft 275 is a drive sprocket 293 which drives the sprocket 59 (see Fig. 7) through a drive chain 293'. As was previously pointed out, the drive sprocket 59 drives the axle 57 and the wheels 56, 56 of the truck 40, which axle 57 in turn drives the axle 52 through the chain 65 to drive the wheels 51, 51 of the truck 40 (Fig. 8). It is thus manifest that the loading machine may be driven through the traction wheels 51, 51 and 56, 56 from the motor 224 either forwardly or reversely at either a high transportation speed or a low feeding speed without requiring reversal of the direction of rotation of said motor 224. It is also obvious that the motor 224 may be operated without requiring movement of the loader on the mine tracks.

As clearly disclosed in Figs. 1, 2 and 7 of the drawings, I provide a power driven electrical cable drum 325 which is pivotally mounted upon the rear bed plate 50 by a shaft journaled in a bearing 326 (see Fig. 7) mounted on an arm pivoted to a bracket 327 carried on the top of an oil reservoir 328 of the hydraulic control system which is described in full detail hereinafter. The drum 325 carries a flexible electrical cable 329 which supplies electrical power to the electric motor 224.

Rigidly attached to the cable drum 325 is a drive sheave 330 driven by a chain 331 from a sheave 332. The ratio of the sheaves 330 and 332 is so selected that the speed of rotation of the drum 325 will be sufficient to pick up the cable 329 to prevent an accumulation of slack thereon even when substantially all of the cable 329 has been paid out and thus the effective diameter of the drum 325 is at a minimum. It will, of course, be evident that the drum 325 will have to rotate at different speeds relative to the speed of travel of the loading machine during the hauling in of the cable 329 due to the effective diameter of said drum 325. To provide for this, it is to be noted that the sheaves 330 and 332 have smooth surfaces and that the chain 331 can slip with respect thereto. Thus, if the drum 325 tends to rotate at a speed too fast for that required to take up the slack in the cable 329, there will be slippage between the chain 331 and one or both of the sheaves 330 and 332.

Furthermore, the sheave 332 is a one-way power driven sheave so that when the mining machine is operating to pay out the cable 329 the tension on said cable 329 is relied upon to rotate it, the cable being hauled in, of course, under power. To provide this one-way drive, the sheave 332 is journaled loosely on a cup sleeve provided with ratchet teeth. The sheave 332 carries a spring pressed pawl which is effective in any position thereof to provide a one-way drive between the cup sleeve and said sheave 332. It is to be noted that the cup sleeve is keyed to the countershaft 275. Also loosely mounted on a portion of the cup sleeve is a haulage or towing cable drum 336 (Fig. 7) with which there is associated a flexible steel cable, not shown, to aid the sumping of the loading machine, when necessary, or to aid it in climbing a hill. In general, it is not necessary to use this flexible steel cable but sometimes severe conditions are encountered wherein it is desired.

To effect a driving connection between the drum 336 and the countershaft 275, the former is provided with jaws adapted to cooperate with the jaws of a sliding clutch member 337 which is feathered to the end of the shaft 275 and operated by a shipper 338 carried on a longitudinally movable shaft 339 having an operating handle. It will be evident that such handle may be operated to effect a driving or non-driving relation between the countershaft 275 and the drum 336.

As clearly illustrated in Fig. 7 of the drawings, a guide pulley 342 is carried on a bracket 343 supported by a plate 50 directly to the rear of the drum 336 to act as a guide for the above-mentioned steel cable. As clearly illustrated in Fig. 7 of the drawings, a pair of guide pulleys 344 and 345 is provided adjacent the rear end of the frame 40 to guide said mentioned flexible steel cable from the rear of the main frame of the truck 40 to extend either rearwardly or forwardly. When the steel cable extends rearwardly it will pass directly from the pulley 342 to the pulley 344 and when it is directed to the front end of the loader it will, in addition, be reeved about the pulley 345 extending forwardly along the side of the truck 40.

It is also to be noted by reference to Fig. 7 of the drawings, that the rear cross-piece 46 of the main frame of the truck 40 carries a guide member 351 having top, bottom and side anti-friction rollers.

As was previously pointed out, the electrical cable drum 325 was mounted upon the pivoted bearing 326 which bearing was attached to an arm pivoted to bracket 327. This provides for shifting of the drum 325 forwardly or rearwardly to tension or loosen the drive chain 331. To effect the shifting of said drum 325 to tension or loosen said chain 331, I provide an operating handle 352 pivoted to a bracket 353 mounted on the oil reservoir 328, which handle 352 is provided with an eccentric crank pin 354 to which is attached a rod 355 extending through an aperture in the bearing 326 and provided with a compression spring 356. When the handle 352 is in its lowered position it will pass over dead center and the spring 356 will urge the bearing 326 to the left, as viewed in Fig. 7, to tension the chain 331. When the handle 352 is lifted the bearing 326 will be moved to the right to release the tension on the chain 331 thereby to permit free rotation of the drum 325. The former condition is desired when the electric cable 329 is drawn in under power and the latter condition is desired when said cable is being paid out freely.

As was previously pointed out, the swinging of the gathering and discharge conveyors 41 and 42, about both their vertical and horizontal axes, is controlled by hydraulic motors. It is, therefore, of course, necessary to provide for the control of these hydraulic motors. To this end the armature shaft of the electric motor 224 extends through the rear of the motor casing, as illustrated in Fig. 7, and drives a hydraulic pump 357, preferably an oil pump, through a chain and sprocket drive mechanism 358. The pump 357 is preferably a relatively high pressure pump capable of producing pressure up to one thousand pounds per square inch and is mounted upon the oil reservoir 328. It will thus be seen that the pump 357 is continuously driven whenever the motor 224 is operated.

It may also be mentioned that the pump 357 is of such a construction that regardless of its

direction of rotation it will always supply pressure at the same port. This is useful to maintain full control of the machine in case the motor 224 is driven in reverse for any reason.

By means of a system of piping and connections including the suction pipe 359 and the supply pipe 360 (Fig. 7), the various double acting hydraulic motors 222, 134 and 102 and the single acting hydraulic motor 194 (Fig. 4), may be operated under the control of the valves connected to the actuating levers 371, 374, 375 and 378 at the operator's station (Fig. 2). Under normal conditions the pump 357 will be operating at no-load but upon operation of any of the control valves in either direction the no-load by-pass will be closed automatically and pressure will be available at any selected hydraulic motor. When any hydraulic motor reaches the limit of its stroke the pressure will be relieved by the by-pass and when the respective valves are each closed its particular hydraulic motor will be locked in adjusted position.

As was previously pointed out, the conveyor chain 165 for the discharge conveyor 42 is not only controllable from a main central control station, where all of the controls are located, but is also controllable by a trip rider by handle 324 (Fig. 2) located adjacent the rear of the truck frame 44. It is also desirable to provide the trip rider with controls for the hydraulic piston motor 194 and the hydraulic motor 222 whereby said trip rider may control the swinging of the discharge boom 169 and the elevation thereof. The trip rider will thus have full control over the discharge conveyor 42. To this end I provide operating handles 423' and 424' (see Fig. 2) adjacent the rear end of the truck 40 and near the handle 324, which are connected to levers 425 and 426, respectively. Thus the control valves 375 and 378 which control the hydraulic motors 222 and 194, respectively, associated with the discharge conveyor to swing it laterally or vertically, are controllable both at the central station and at the station adjacent the rear of the truck 40.

Reversal of the truck propelling mechanism in order to advance and retract the gathering conveyor in the loading operations, is controlled by the lever 441 which when moved in one direction will effect the application of the clutch 259 and when moved in the opposite direction will effect the application of the clutch 260 (Fig. 7). Movement of the lever 441 in either direction actuates the intermeshing bevel gears 442, 443 to move the rods 431 and 269 axially to slide the latter axially of the shaft 262 and thus operate either the clutch 259 or the clutch 260 to effect transmission of power from the motor 224 to the shaft 262 and from the latter to the shaft 275. The speed reducing gearing driven by the pinion 272 (Fig. 7) effects rotation of the shaft 275 at two different speeds and therefore the machine may be advanced at a slow feeding or sumping speed or at a fast or transportation speed. In a similar manner the machine may be moved rearwardly at slow or fast speeds under the control of the clutches 285, 286 shown in Fig. 7. It should be understood that the shafts 262 and 275 always rotate in opposite directions whether the truck is driven at slow speed or fast speed and that reversal of the truck propelling mechanism depends upon the alternate applications of the clutches 259, 260.

The electric motor 224 should be constantly driven in the same direction so as not to reverse the directions of travel of the conveyor chains on the gathering and discharge units. However, without reversing the motor 224, the clutches 259, 260 may effect reversal of the truck propelling mechanism.

Attention is now directed particularly to Fig. 9 of the drawings, which illustrates diagrammatically the hydraulic system for controlling the several fluid pressure motors. The in-put to the pump 357 is fed from the reservoir 328 by a suction pipe 359. A by-pass pipe 361, including a high pressure relief valve 362, connects the pressure pipe 360 to the reservoir 328. The pressure pipe 360 leads to a no-load by-pass valve 363, hereinafter described in full detail, which, in turn, directs the oil under pressure to a common pressure chamber 364 (see Fig. 11) of a control valve manifold 365. The by-pass valve 363 when in by-pass opening position, directs fluid from the pipe 360 to a by-pass return pipe 366 leading to the oil reservoir 328. The manifold 365 is also provided with a return flow oil chamber 367 (see Fig. 10) which is connected to the return pipe 366 by a pipe 368 (see Fig. 9).

Leading from the manifold 365 to the ports 117 and 118 of the double acting piston motor 102 for elevating the gathering conveyor 41, are pipes 369 and 370, respectively, controlled by valve 371, which is similar to valve 375 hereinafter described in full detail. Also leading from said manifold 365 to the opposite ends of the piston motor 134 for swinging the gathering conveyor 41, are pipes 372 and 373 controlled by a valve 374 which is similar in construction to valve 375. Valve 375 (see Fig. 10) is provided on manifold 365 and controls pipes 376 and 377 leading to the motor 222 for swinging the boom of the discharge conveyor 42. Another valve 378 is provided on manifold 365 which is similar to valve 375 except that only one of the pressure ports is employed, the other being plugged up, said one pressure port leading to pipe 379 connected to motor 194 for elevating the boom 169 of the discharge conveyor 42. Interposed between the pipe 379 and the return pipe 366 is a high pressure relief valve 380 which is effective to relieve the pressure on the boom 169 of the discharge conveyor 42 in case an overload is placed on said boom. It may be pointed out that the construction of the valves 371, 374, 375 and 378 is such that fluid in the pipes 369, 370, 372, 373, 376, 377 and 379 may be locked against movement in either direction. As a consequence, the movable elements of all the hydraulic motors 102, 134 and 222 may be locked in position. It is furthermore to be noted that each of said motors may be moved positively in reverse directions.

Attention is now directed particularly to Figs. 10 and 11 and to the construction of the by-pass valve 363, the manifold 365, and the operating valve 375 as representative of the four valves 371, 374, 375 and 378. The by-pass valve 363 comprises a body casting 383 having a horizontally extending cylinder 384 within which moves a hollow piston 385 having a longitudinally extending bore 386 and communicating transversely extending bores 387. The casting 383 also provides a circumferential oil chamber 389 providing communication between an inlet port 390 and an outlet port 391 of the casting 383. Within the piston 385 in the position illustrated in Fig. 11, oil from the pressure line 360 will flow from the chamber 389 to the return pipe 366 which is connected to the casting 383 by a fitting 392 by way of bores 386 and 387. It is thus obvious that

in this position the by-pass valve 363 provides a substantially no-load by-pass for the pump 357. This is the normal condtion of the by-pass valve 363 and is realized when none of the control valves 371, 374, 375 or 378 is operated. Should any of the mentioned control valves be operated the piston 385 will move to the right, as viewed in Fig. 11, regardless of the direction of movement of the operating handle of the control valve, as hereinafter described in full detail, to close the by-pass by shutting off communication between the oil chamber 389 and the bores 387.

The piston 385 is provided with a plurality of spaced piston rings 393, there being groups of three on each side of the bores 387, to prevent leakage into the return pipe 366 when said piston 385 is in by-pass closing position. The piston 385 is provided with an operating rod 394 with which is associated a packing gland 395 to prevent any leakage of fluid from the by-pass valve 363. When the by-pass valve 363 is in by-pass closing condition, as above described, fluid in the chamber 389 will be communicated to the pressure chamber 364 of the manifold 365 by way of the hollow coupling 396 which supports the casting 363 from the manifold 365. The pressure chamber 364 runs longitudinally of the manifold 365 to provide oil under pressure to all of the control valves 371, 374, 375 and 378.

The construction of the valve 375 is illustrated in detail in Fig. 10, and, as above mentioned, is representative of the valves 371, 374, 375 and 378. The by-pass valve 363 and the operating mechanism therefor are important features of my invention and are hereinafter described in full detail. It may be stated briefly that the valve 375 comprises an operating handle 397 pivoted upon a bifurcated bracket 398 and held in a normal upright position by spring means 399 and cooperating stop pins 400 and 401 carried respectively by the bracket 398 and the handle 397. The handle 397 is pivotally attached to an operating shaft 402 formed integral with a pair of control pistons 403 and 404 by a link 405.

It may be stated that when the handle 397 is moved to the right, as viewed in Fig. 10, the pistons 403 and 404 will be moved to the right to effect a communication between the pressure chamber 364 and the individual valve chamber 406 thereby to direct fluid under pressure to the pipe 376, which will be effective to operate the hydraulic piston motor 222 and thereby swing the rear part 171 of the discharge boom 169 in one direction about its pivot 182, the return path from the motor 222 being provided over pipe 377 by way of valve chamber 407 to oil return chamber 408 which is in constant communication with the general oil return chamber 367, Fig. 10. When the handle is moved to the left, as viewed in Fig. 10, oil under pressure in the pressure chamber 364 is communicated by valve chamber 407 to pipe 377 to operate the piston hydraulic motor 222 in the reverse direction, the return path for the oil being provided by pipe 376, valve chamber 406 to return chamber 409 which is also in communication with the general oil communication chamber 367. It is, of course, evident by referring to Fig. 10 of the drawings, that when the lever 397 is in its normal, neutral position the pistons 403 and 404 lock the pipes 376 and 377 full of oil and thus lock the hydraulic motor 222 thereby holding the boom 169 in any predetermined horizontal position.

It will be evident that in a similar manner the valves 374, 371 and 378 may be operated to control and lock the motors 134 and 102 and to control motor 194. It may be mentioned, however, that the valve chamber similar to chamber 406 associated with the pipe 379 is merely plugged up instead of provided with a conduit, such as conduit 376 of valve 375.

It is to be noted that the manifold 365 is supported upon spaced brackets 409' and 410 (Fig. 2) supported respectively from the bed plate 49 and the side member 158 of hopper 155. The brackets similar to the bracket 398 of valve 375 are removably attached to a cross-piece 411 which extends between the brackets 409' and 410.

To provide for the operation of the piston 385 of the by-pass valve 363 in the same direction to by-pass closing position, whenever any of the operating handles of the valves 374, 371, 375 and 378 are operated thereby to insure pressure in the pressure chamber 364 only when one of said control valves is operated, I provide mechanism now to be described. Said mechanism comprises a longitudinally extending shaft 412 having four operating levers associated with the valves 371, 374, 375 and 378, the lever associated with the valve 375 being seen at 413, which lever 413 is attached by a set screw 414 to rotate the shaft 412. All of the levers corresponding to the lever 413 are likewise attached to rotate with the shaft 412. Lever 413 is provided with two adjustable stops 415 and 416 of which stop 415 contacts the operating lever or handle 397 and stop 416 contacts an integral extension of said lever 397 which is below the pivot point thereof provided by pin 417. It is thus manifest that upon the operation of the lever 397 in either a clockwise or a counter-clockwise direction the lever 413 will be operated in a counter-clockwise direction. (Fig. 10.)

Also rigidly attached to the shaft 412 by a set screw 418 (see Fig. 11) is a crank 419 attached by a link 420 to the center of a pivoted lever 421, the free end of which is attached to the operating rod 394 of the piston 385. It will thus be seen that upon the movement of the handle 397 in either direction, the piston 385 is operated in the same direction and to the left, as viewed in Fig. 11, to effect a closure of the by-pass, as previously described.

By reference to Fig. 12 of the drawings, it will be seen that the lever 413 is urged in a clockwise direction by a spring 422 coiled about the shaft 412, one end of which is attached to a short lever 423 rigidly attached thereto by a set screw 424, the other end of which is attached to the bracket similar to bracket 398 associated with valve 378. As previously mentioned, operation of the control handles of any of the valves 371, 374, 375 or 378 will be effective to rock the shaft 412 in the same direction thereby to close the by-pass valve 363. It is thus evident that under normal conditions the pump 357 will be operating at no-load but that upon the operation of any of the control valves in either direction the by-pass valve will be closed automatically and pressure will be available into the desired work.

In the operation of the loader comprising my invention, it may be trammed along a trackway in a mine to the place where the loading operation is to take place. During this tramming operation the drive wheels of the truck will be driven at their fast speed and the electric cable will be paid out freely. The gathering conveyor will be elevated with its front end above the

tracks by means of the hydraulic motor 102 and both the gathering and the discharge conveyors may be controlled by the operator who rides on a small platform on the truck 40 adjacent the above described controls, to swing said gathering and discharge conveyors, as required by the travel of the loader along a curved track.

Should a very steep incline be encountered it may be necessary to employ the flexible steel cable or rope associated with the drum 336 and reeve it about the two pulleys 344, 345 (Fig. 7) with the free end attached to a mine jack. This arrangement is particularly desirable when traction feed tends to cause the truck wheels to slip on the mine track.

When the loading machine has reached the place where the coal is to be loaded, which coal has been previously cut and shot, with part thereof formed as loose coal and part formed as a semi-compact mass, the driving gears will be changed to drive it at a slow or sumping speed. The operator will then adjust the gathering conveyor 41 and the discharge conveyor 42, the former by lowering it in contacting relation with the mine tracks or, if the first operation is to take place adjacent the side of the mine tracks, to lower it into contact with the mine floor with the discharge conveyor 41 positioned to discharge into a mine car 43.

With the conveyor mechanisms of the discharge and gathering conveyors set into operation, and with the front end of the gathering unit resting on the mine floor in advance of the mine track, the entire machine may be fed forwardly providing a frontal attack of the gathering conveyor 41 on the coal at the bottom of the mass of material to be loaded. The flights 143 and 144 will dig into the loose or semi-compact coal and feed it to the gathering conveyor 41.

One special feature of operation of my device lies in the fact that the gathering flights 143 and 144 of the gathering conveyor 41 attacks the coal at the same time and in opposite directions to secure a balancing effect, thereby reducing to a minimum any tendency for the loader to jump off the tracks during the operation of the gathering mechanism.

A further very important feature of the operation of the flights 143 and 144 also lies in the wedging action which they have due to the inclined serrated rib or comb 146. Due to this construction the flights tend to wedge under the coal, particularly when in a semi-compact mass, thereby breaking it down and at the same time providing a minimum of degradation due to the lack of a striking action comparable with a hammer blow.

It may also be mentioned that a low degradation is realized with my loader due to the fact that there is only a single rehandling of the coal by the loader, namely, at the hopper 155. This, of course, is realized by virtue of the fact that the gathering conveyor unit comprises continuous gathering mechanisms which operate through substantially the entire length thereof.

It is also to be noted that due to the fact that flights 143 and 144 extend laterally over the opposite edges of the flat working portion 87 (Fig. 2) of the bottom plate 86 there is no tendency for the gathering conveyor to become wedged in the pile of coal, particularly when it is in the form of a semi-compact mass. Furthermore, a swinging or side attack on the coal may be carried out due to this particular construction. This is particularly useful in a final clean-up for, in general, I prefer to operate the device as a frontal attack loading machine.

Another important feature of my invention lies in the fact that the double acting hydraulic piston motor 102 may be relied upon to suspend the front end of the truck from the gathering conveyor frame when the front wheels 51, 51 are off the mine track and located beyond the front end thereof while the front end of the gathering conveyor is supported on the mine bottom at its working portion 87. In such event the hanger plates 122 (Fig. 6) rest on the nuts 127 and the locked hydraulic motor 102 supports the front end of the turntable 68 and the latter in turn by means of the arcuate lifting plate 131 supports the front end of the truck 40 with the front wheels off the mine track and spaced above the mine bottom beyond the front end of the mine track. It will thus be seen that the reach forward of the gathering conveyor may be extended without lengthening the mine track, it being necessary to retain only the rear wheels 56 on the mine track during the extended loading operations.

Furthermore, the double acting piston motor 102 is particularly useful to place the truck 40 back on the rails 66 if for any reason it is derailed. It is, of course, evident that the front wheels may be elevated and swung back over the rails by means of the reciprocating hydraulic motor 134 and then lowered to the rails by means of the motor 102. The rear wheels 56 may be elevated by placing a jack between the front portion of the bottom plate 86 and the mine roof and expanding the piston motor 102, in which case the rear end of the truck 40 will be elevated about a pivot formed by the front wheels 51 and the axle 52; then by operating the piston motor 134 while the front end of the gathering conveyor remains anchored between the floor and the roof, the rear end of the truck may be swung into position so the wheels 56 are aligned with the track rails 66, after which the motor 102 is again operated to lower the rear wheels 56 onto the mine track rails.

During normal operation, the conveyor boom 83 rests on the springs 126, 126, while the front wheels are on the mine track. When the gathering conveyor is adjusted in elevation the hydraulic motor 102 acts through the springs 126, 126 on the bottom plate 86 of the boom 83 but when the upward movement of the gathering conveyor is resisted by dislodged coal fallen from the semi-compact mass onto the receiving end of the gathering unit 41, the springs 126, 126 may be compressed until the channeled crossmember 121 (Fig. 6) engages the transversely extending bar 124 to effect a direct, powerful and positive lifting of the receiving end of the gathering unit from the mass of dislodged coal. At the same time the truck propelling mechanism may be reversed to effect withdrawal of the gathering unit from such mass of dislodged coal.

It is also to be pointed out that all of the control levers for the mining machine are positioned at a single control station where they may be readily operated by the principal operator. Furthermore, due to the hydraulic control provided for swinging both the gathering and the discharge conveyors, the amount of work required by the operator is reduced to a minimum, being only that necessary to operate the control levers.

Furthermore, the complete control of the discharge conveyor 42 is extended to a position at the rear of the truck 40 where it may be operated

by the trip rider. In this connection it will, of course, be evident that the main operator's attention will be required largely by the gathering conveyor and the trip rider will control the discharge conveyor.

It is also to be pointed out that a single electric motor is provided for operating the entire loading machine including the providing of fluid pressure for the hydraulic control system. No auxiliary electric motor of any kind is required on the loading machine comprising my invention.

A general review of the construction and operation of the mining and loading machine shown in the accompanying drawings will show more clearly the flexibility of adjustments to obtain the most efficient operation in mining and loading coal by attacking a semi-compact mass of coal shot down from the face of a coal vein. Under control of the valve 378 shown in Fig. 2 the rear end of the discharge conveyor 169 may be adjusted in elevation to the full line and dotted line positions shown in Fig. 3, by means of the vertical reciprocating hydraulic motor 194. By means of the valve 371 shown in Fig. 2 the upright reciprocating hydraulic motor 192 may be operated to adjust the front end of the gathering conveyor to its full line or dotted line positions shown in Fig. 2. When the gathering conveyor is in the full line position shown in Fig. 2, the whole machine may be transported along the mine track under the control of the forward operator who may start or stop the electric motor 224 of Fig. 4 by means of motor controlling mechanism. By means of a reversing switch the operator may reverse the electric motor 224 and thereby control the direction of travel of any of the conveyor chains should they become stalled.

The truck propelling means comprises power transmission mechanism between the electric motor 224 and all of the wheels 51 and 56 of the truck, as shown in Figs. 4 and 7. This power transmission mechanism is under the control of the clutch 229 in Fig. 4. The operator may apply or release the clutch 229 by rocking the shaft 247 (Fig. 4). The truck propelling power transmission mechanism also includes reversing clutches 259 and 260 shown in Fig. 7, either of which may be applied by the operator actuating the lever 441 in one direction or the other and consequently the loading machine during operation may be moved along the mine track in either direction without reversing the electric motor 224.

When the shaft 262 of Fig. 4 is rotated in one direction or the other, the pinion 272 thereon drives the reduction gearing shown in Fig. 7, which is under the control of the clutches 286 and 285 for the purpose of securing relatively low speed and relatively high speed of transmission to the transverse shaft 275.

A sprocket chain drive comprising the sprocket 293 on the shaft 275, connects the shaft 275 with the axle 57 shown in Fig. 7. It will thus be seen that the electric motor 224 may be continuously operated in the same direction while by means of the clutches 259 and 260 in Fig. 7, the gathering mechanism may be moved forwardly or rearwardly under the control of the operator, and such forward or rearward movement may be at relatively fast speed or at relatively slow speed under the control of the clutches 285 and 286 of Fig. 7. A slow powerful sumping movement into the semi-compact mass of shot down coal may thus be effected, and whenever desired a slow, powerful withdrawal movement of the gathering mechanism may also be effected.

The power transmission mechanism connected between the motor 224 and the pair of endless conveyor chains on the gathering device 41, comprises the gear 240 on the vertical shaft 230 of Fig. 4. The gear 240 meshes with the gear 251 which in turn meshes with the gear 254, and the latter is in mesh with one of the gears 256 as shown in Fig. 8. Since the gears 256 mesh with each other, the flights of the gathering conveyor are in such fixed relation to each other that they travel in pairs, in opposite directions, as illustrated in Fig. 1. The starting and stopping of the pair of endless chains of the gathering conveyor are controlled by the clutch 229 shown in Fig. 4. During normal operation of the gathering conveyor the flights move in pairs towards the discharge conveyor 171 and therefore the motor 224 should be continuously operated in the same direction. Should a lump of coal get caught between the rear end portion of the gathering conveyor and the roof of the mine chamber, the crowding and wedging action will be downward against the upwardly extending serrations of the flights 143, 144 (Fig. 1) and against the points of the cutter bits 145, thereby effecting a crushing of the unusually large lump of coal so that delivery of the coal to the discharge conveyor need not be interrupted. If there is an overload on the gathering conveyor chain 91 due to contact between flights 143 or 144 and solid or irremovable coal, the friction clutch 229 will slip, whereupon the proper clutch 259 or 260 may be operated to cause the machine to move rearwardly thereby causing the conveyor flights 143 and 144 to release the contacted coal and relieve the overload.

Under the control of the lever 374 shown in Fig. 2, the operator may control the swinging of the gathering conveyor laterally on its vertical pivotal connection at 255 (Figs. 4, 5) to the truck frame 44, and during such lateral swinging movement of the gathering conveyor its frame 68 rests at its forward end on the rollers 128, as shown in Fig. 5. A single reciprocating hydraulic motor 134, pivotally connected at its ends to the truck frame and the gathering conveyor frame, is relied on to swing the forward end of the gathering conveyor laterally to various angular positions relative to the mine track. The gathering conveyor may be locked by means of the motor 134 in its angular, adjusted position when the loading machine is to be sumped or withdrawn rectilinearly parallel to the mine track, but it should be understood that the reciprocating hydraulic motor 134 is sufficiently powerful to swing the forward portion of the gathering conveyor in either direction for lateral attack on a semi-compact mass of shot-down coal, and at various elevations illustrated in full and dotted lines in Fig. 2.

After a mine vein has been undercut and shot down it may remain standing for several feet back from the face in a semi-compact mass termed a "standing shot." Some of this may be "tight" at various elevations but the frontal attack of the gathering unit may be relied on to effect a V-shaped kerf in such semi-compact standing mass at the mine bottom or at various elevations to complete the dislodgment of the coal and its falling onto the receiving end of the gathering unit.

The discharge conveyor comprises two sections 170 and 171 (Fig. 4), with the rear section 171 movable laterally on the upright pivot 182. Hydraulically operated mechanism comprising the hydraulic motor 222 is controlled by the valve 375 (Fig. 2) to effect power swinging of the rear

section of the discharge conveyor. By means of the mechanism shown in Fig. 1 the continuity of the sides of the conveyor trough 171 is maintained notwithstanding the fact that the discharge conveyor comprises a single endless chain 165 having links pivotally connected on vertical and horizontal axes, this chain being similar in construction to the chain 91, as shown in Fig. 5.

The cable reel 325 (Fig. 1) may be operated by power to wind up the cable 329 which contains the insulated wires connecting the motor 224 to the distant source of electric power supply. The pawl and ratchet mechanism permits paying out of the cable 329 as the machine moves forward.

By applying the clutch 337 and rotating the shaft 275 in a clockwise direction, as viewed from the right-hand side of the machine, the rope drum 336 may be rotated to move the whole machine along the mine track either for moving up a steep grade, or for moving the gathering mechanism into a compact mass of shot-down coal, particularly when the wheels tend to slip with traction feed. In such event one end of the feed rope is connected to and wound on the drum 336, and the free end anchored extraneously to the loading machine and at such a position that the machine will be pulled forwardly when the drum 336 is rotated.

When the clutch 337 is applied the rope drum 336 is connected directly to the shaft 275. Consequently by rotating the shaft 275 in either direction the drum 336 may be rotated in the same direction to effect winding of the cable on the cable reel 336.

It is preferred that a main operator should be in a position to operate all of the controlling levers and that another operator should be able by means of extended actuating connections, to control adjustments of the discharge conveyor independently of the operation of the gathering conveyor. As the mine cars are brought up, loaded, and replaced by empty cars, a rear operator may start and stop the discharge conveyor and adjust the elevation of the rear end thereof as well as its lateral position. The main operator will know when the discharge conveyor stops without looking backward and thus stop the gathering conveyor to prevent overflow from hopper 155.

Whenever the electric motor 224 is operating, the pump 357 by means of mechanism shown at the left-hand end of Fig. 7 is being continuously operated so that at all times the hydraulic system is in readiness for performing the various adjustments by means of the hydraulic reciprocating motors 102, 134, 194 and 222. The controlling valves 371, 374, 375 and 378 when released, automatically move to their neutral positions where the hydraulic motors are locked, thus rigidly holding the various parts in adjusted positions. It is important to note that whenever a controlling valve is manually released it is returned automatically to neutral position and at the same time the by-pass valve 363 is automatically moved to no-load position. The high pressure valve 362 opens only when the maximum output of pressure is exceeded but when the valve is opened, a very free passageway is provided for by-passing the liquid continuously pumped by the pump 357 while the main motor 224 is continuously operating.

It should be understood that when the gathering conveyor unit is swung laterally the hopper 155 of the discharge conveyor apparatus remains stationary. The rearwardly extending wings 161, 161' shown in Figs. 1 and 5 have their lower edges in overlapping relation to the upper semi-circular edge of the semi-funnel shaped chute 159. Such wings 161, 161' move bodily with the gathering conveyor unit. As the flights leave the rear edges of the plate 80 they move away from each other and any material thrown laterally will be deflected by the wings 161, 161' into the hopper 155. Furthermore, such wings extend upwardly from the lateral edges of the chute 159 to cooperate with the latter to deepen the hopper 155.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. A loading machine comprising the combination with a wheeled truck adapted to travel on a mine track, of a conveyor apparatus including a forwardly extending gathering unit pivoted to the wheeled truck at its rear end portion on horizontal and vertical axes with the forward end of said gathering unit resting on the ground in advance of said wheeled truck, and fluid pressure motor mechanism connected to said gathering unit to depend therefrom and adapted to lift the wheeled truck when derailed for replacement on the track while the forward end of said gathering unit rests on the ground as aforesaid.

2. A loading machine comprising the combination with a wheeled truck adapted to travel on a mine track, said truck having two pairs of wheels, of a gathering unit mounted on said truck, a turntable on said truck, a pivotal connection between said gathering unit and said turntable on a horizontal axis, means comprising a hydraulic motor for rotating said turntable to swing said gathering unit on the upright axis of the turntable, means comprising an additional hydraulic motor between said gathering unit and said turntable for swinging the gathering unit on said horizontal axis to adjust the elevation of the forward end of said gathering unit, and means for controlling said hydraulic motors while the forward end of the gathering unit rests on the ground to effect lifting and turning of the trunk in either direction when derailed and thereby replace the wheels of the truck back onto the track.

3. In a track mounted loading machine, the combination with a wheeled truck adapted to travel along a mine track and comprising a truck frame having a forwardly projecting plate, of a supplemental frame mounted on said truck frame, a connection between said supplemental frame and the said forwardly projecting plate, a gathering conveyor mounted on said supplemental frame in position for its outer end to rest on the surface from which the material is to be gathered in advance of the mine track, a fluid pressure motor, and means for connecting said motor between said supplemental frame and said gathering conveyor in position to enable such motor to adjust the elevation of said gathering conveyor relative to such surface when the truck is on the mine track and to lift by means of the aforesaid connection the forward end of the truck relatively to the track when the truck is derailed.

4. In a loading machine, the combination with a wheeled truck adapted to travel on a mine

track and comprising a truck frame having a forwardly extending arcuate plate, of a supplemental frame mounted on said truck for arcuate adjustment relative thereto on an upright axis, a gathering conveyor pivotally connected to said supplemental frame on a horizontal axis with the forward end of said gathering conveyor adapted to rest on the surface from which the material is to be loaded in advance of the mine track, an arcuate support on said supplemental frame in position to extend under said forwardly extending arcuate plate, means for swinging said gathering conveyor on said upright axis relatively to said truck when the latter is on the mine track, and means for adjusting said gathering conveyor on said horizontal axis relative to said supplemental frame so connected between the latter and said gathering conveyor that when the forward wheels of said truck are derailed said swinging means shall be capable in co-operation with said adjusting means in replacing said front wheels on the mine track while the forward end of said gathering conveyor is held against swinging laterally.

5. A loading machine comprising the combination with a truck having front wheels and rear wheels adapted to travel on a mine track, of a gathering unit mounted on said truck for adjustment relative thereto on a horizontal axis, said gathering unit projecting forward from said truck with its front end adapted to rest on and slide along the mine bottom in advance of the mine track, means comprising a double acting hydraulic motor depending from the gathering unit and connected to the front end of the truck, means for moving the loading machine along the mine track to enable said gathering unit to gather a load of loose material from the mine bottom in advance of the mine track, and means for controlling said hydraulic motor to elevate the receiving end of the gathering unit above the mine bottom while the front wheels of the truck are on the mine track or to lock the motor while the front end of the gathering unit rests on the mine bottom to enable such motor to suspend the front end of the truck with the said front wheels up off the mine bottom while off the track and in advance thereof to extend the gathering operations in advance of the mine track.

6. In a machine of the class described, the combination with a supporting frame, of a gathering conveyor mounted thereon, a hydraulic piston motor comprising a cylinder, a piston and a piston rod, a yoke connected to the piston rod, spring means attached to the legs of said yoke and to said gathering conveyor and so constructed and arranged that said gathering conveyor is supported by said piston rod through said spring means, means connecting said cylinder to the forward portion of said frame, and means for adjusting and locking said piston in said cylinder.

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