Aug. 5, 1941. W. E. EHINGER 2,251,667

SELF-PROPELLING LOADER

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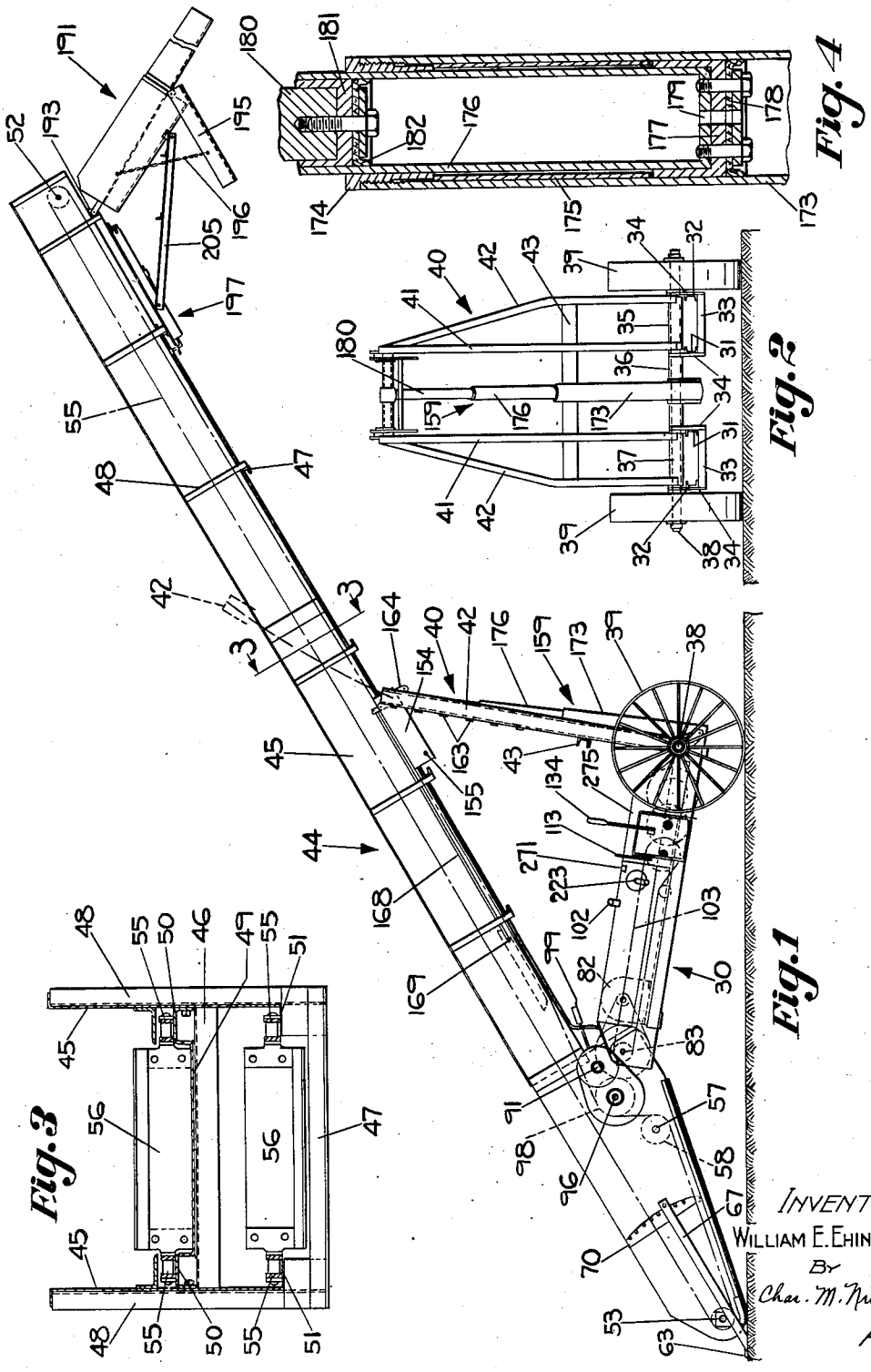


Fig. 1



Fig. 2



Fig. 3



Fig. 4

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SELF-PROPELLING LOADER

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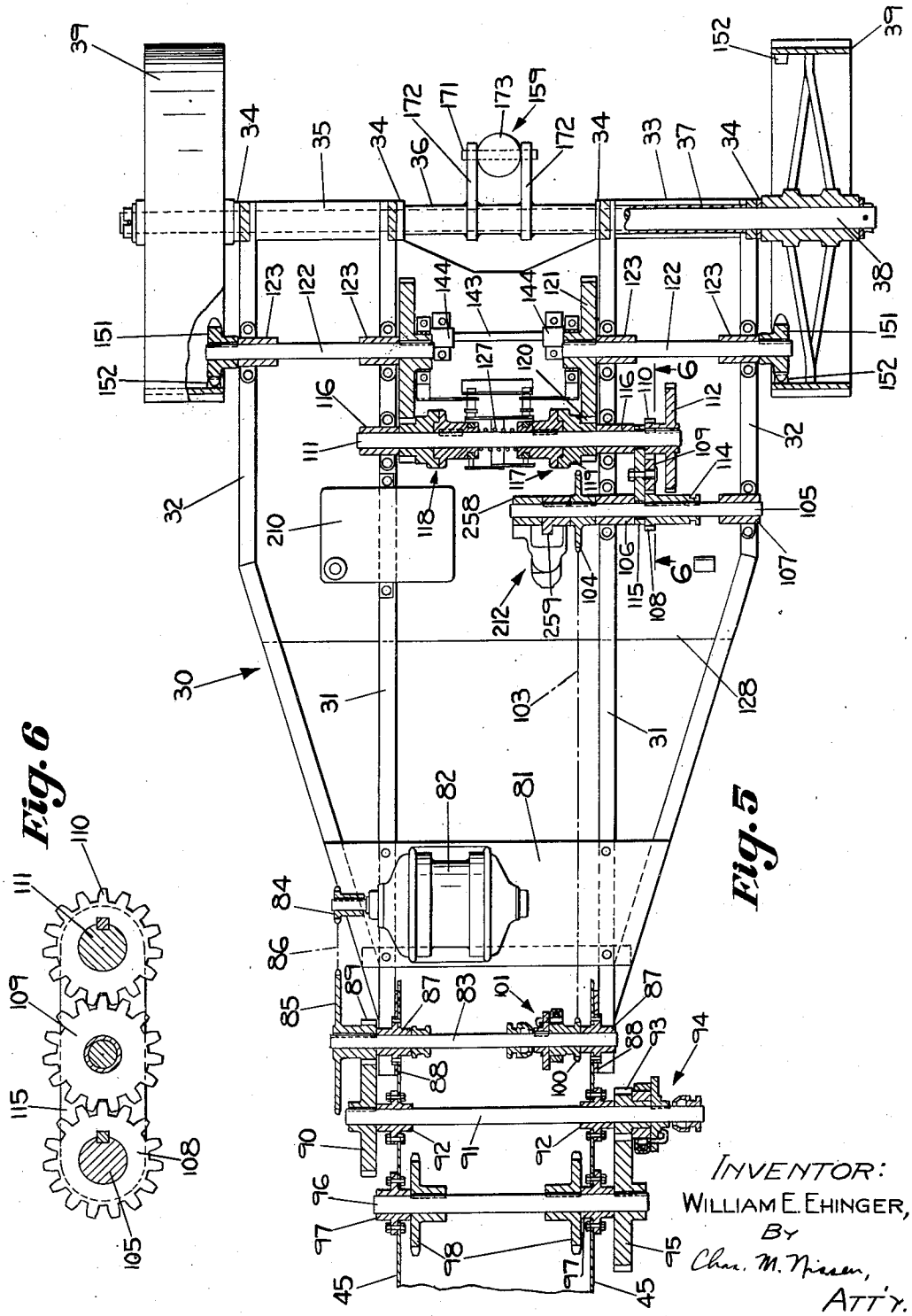


Fig. 5



Fig. 6

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SELF-PROPELLING LOADER

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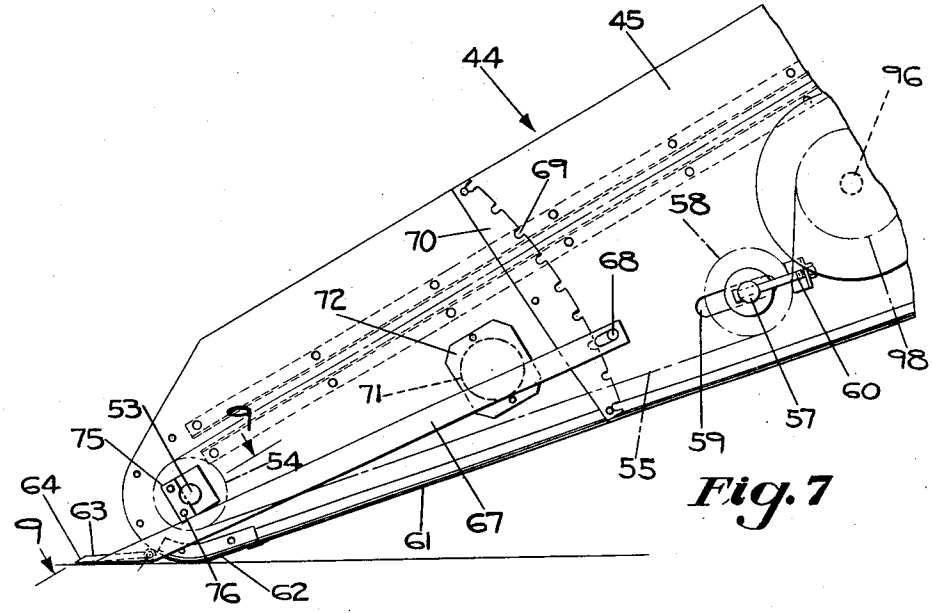



Fig. 7

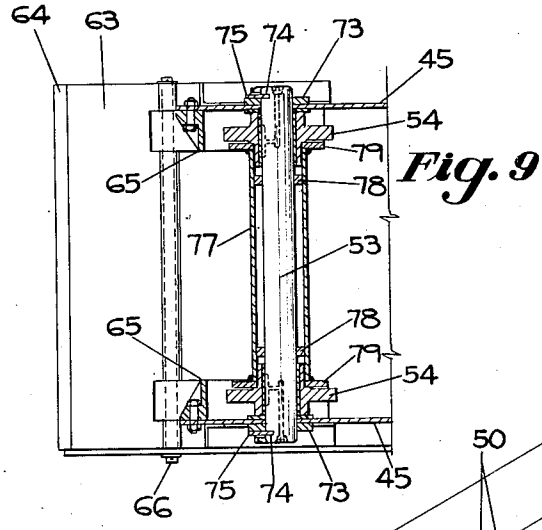



Fig. 9




Fig. 8

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SELF-PROPELLING LOADER

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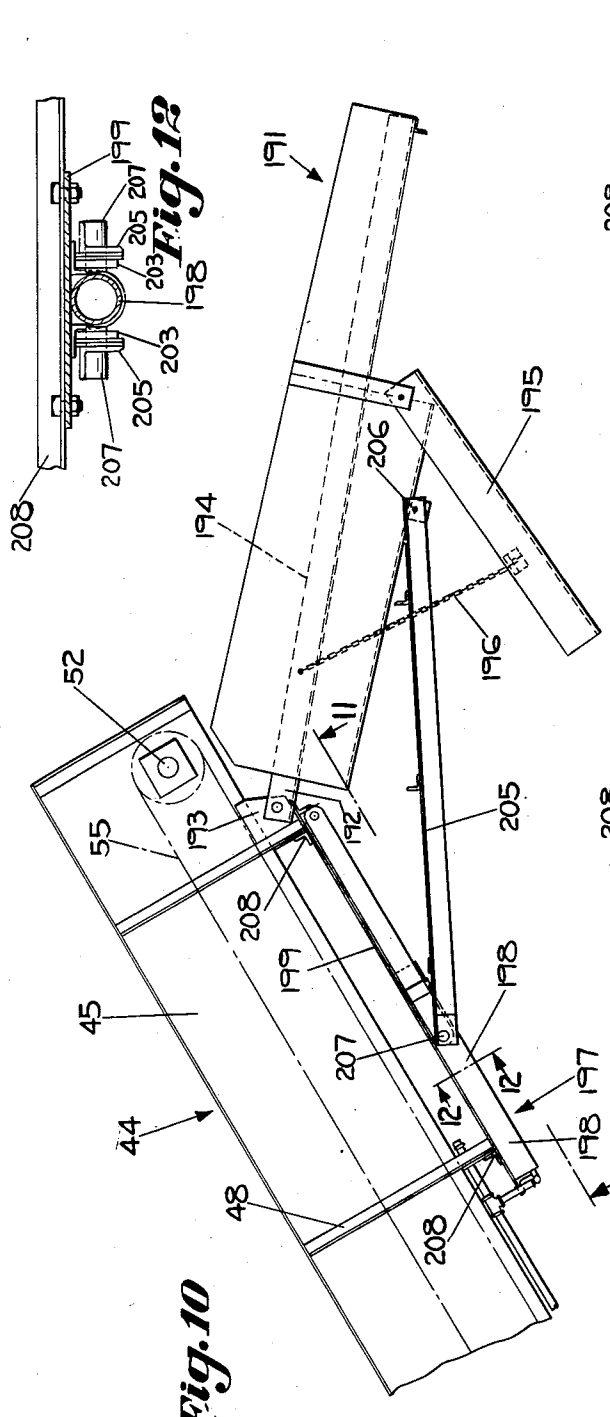



Fig. 12

Fig. 10

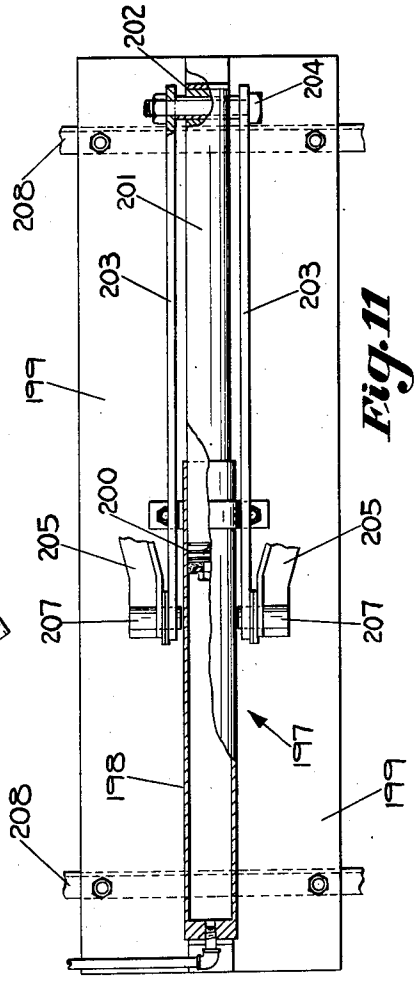



Fig. 11

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SELF-PROPELLING LOADER

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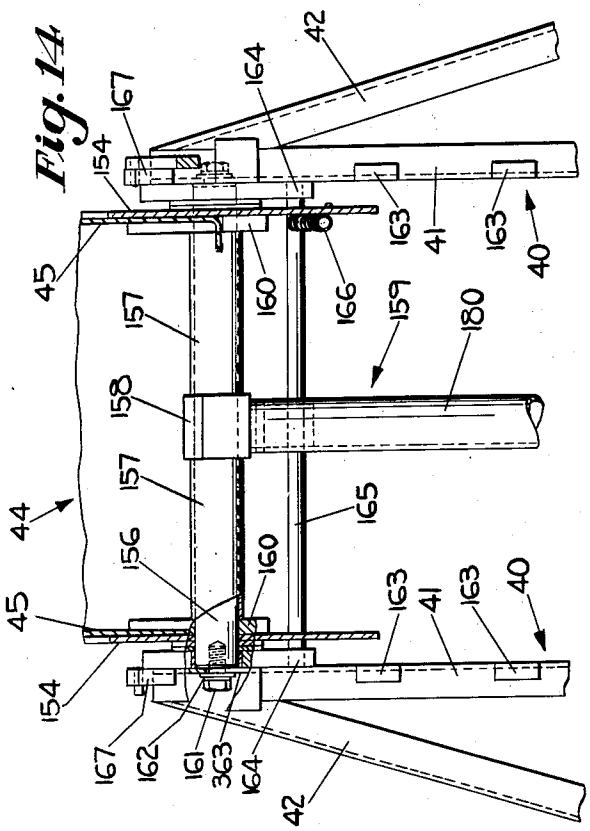



Fig. 14

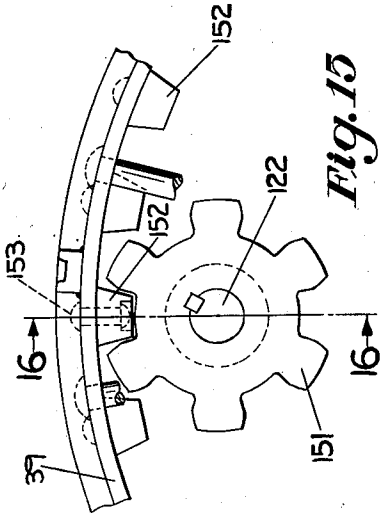



Fig. 15

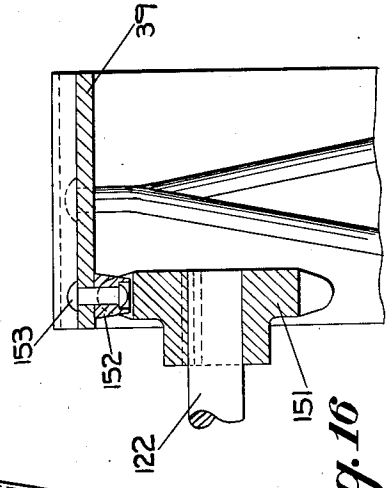



Fig. 16

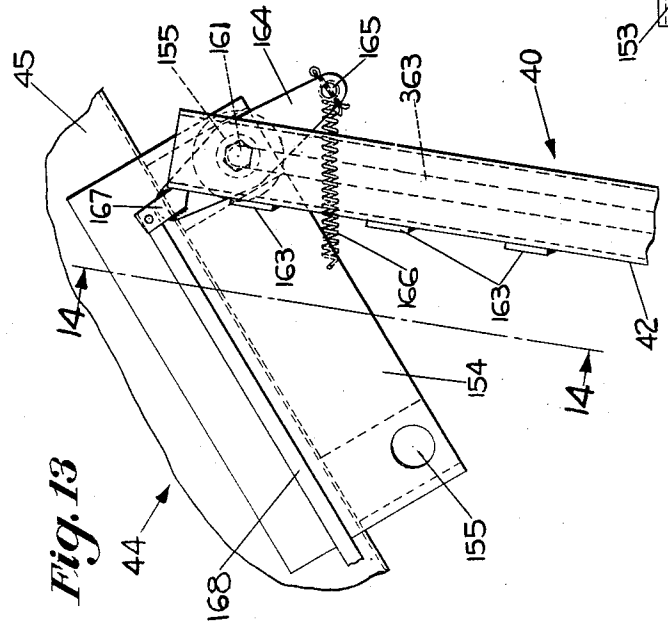



Fig. 13

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SELF-PROPELLING LOADER

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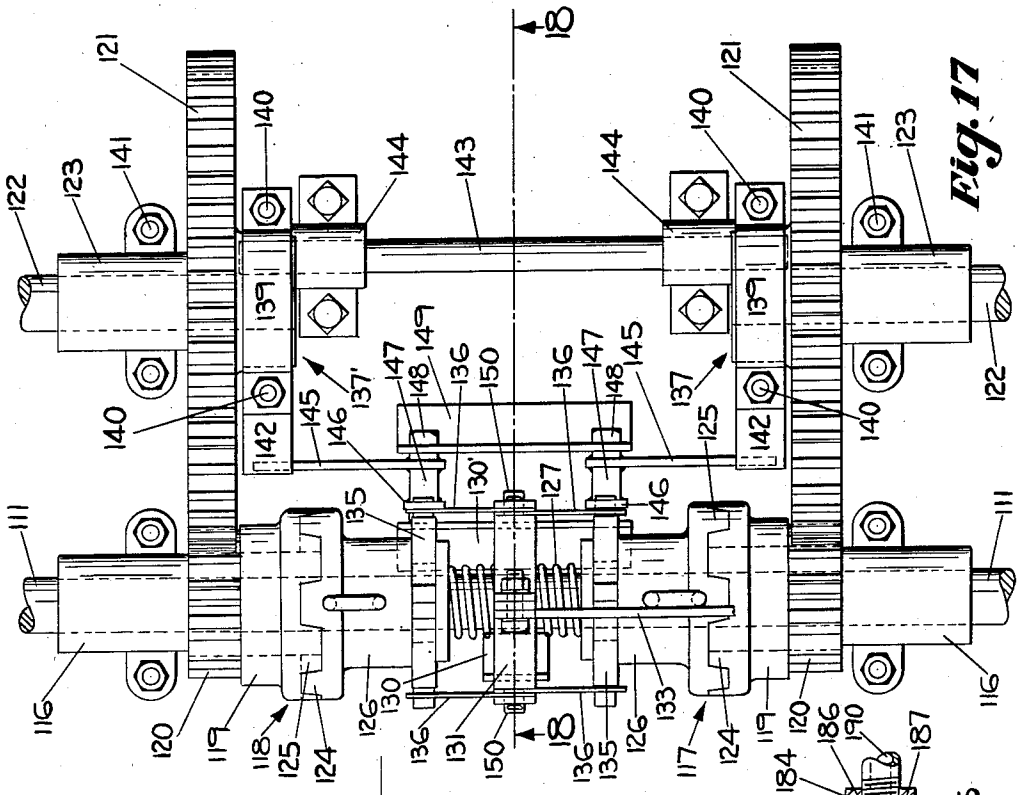


Fig. 17

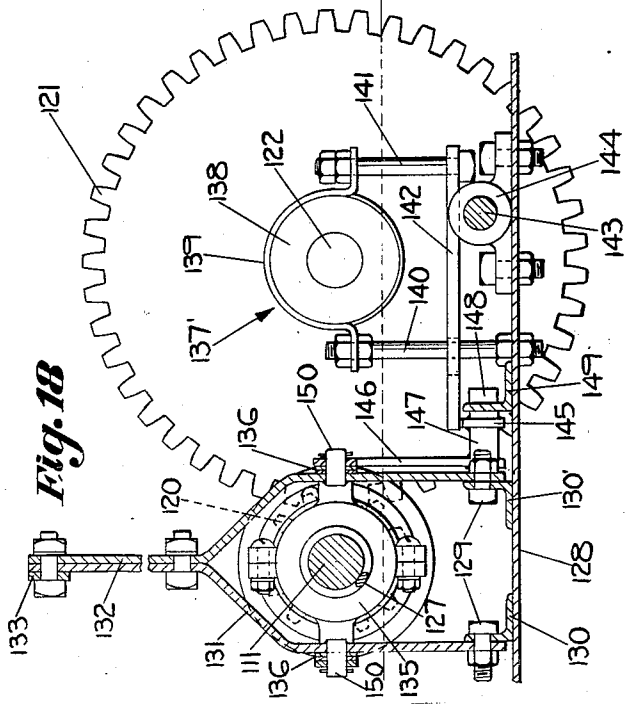


Fig. 18

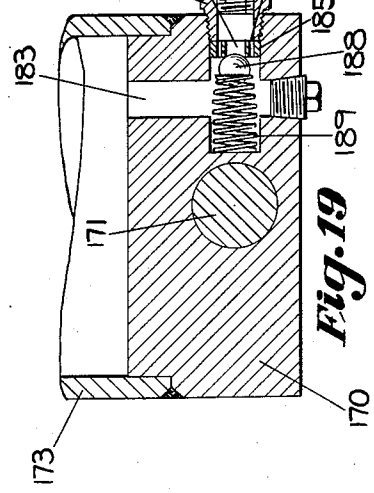


Fig. 19

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SELF-PROPELLING LOADER

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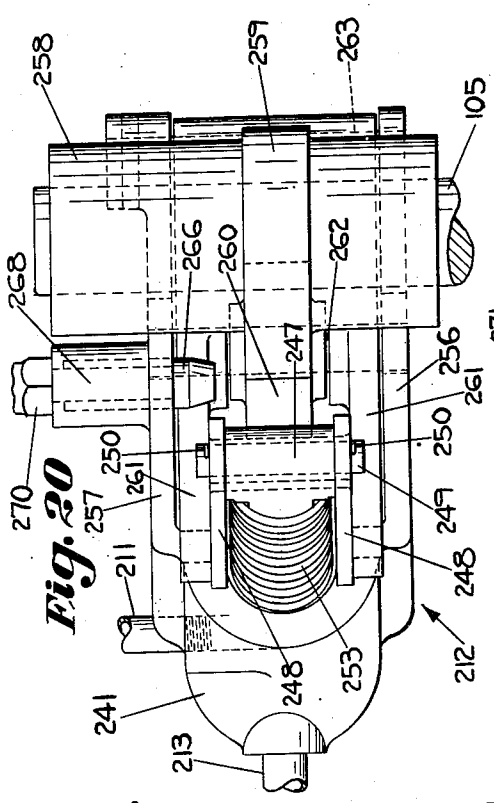



Fig. 20

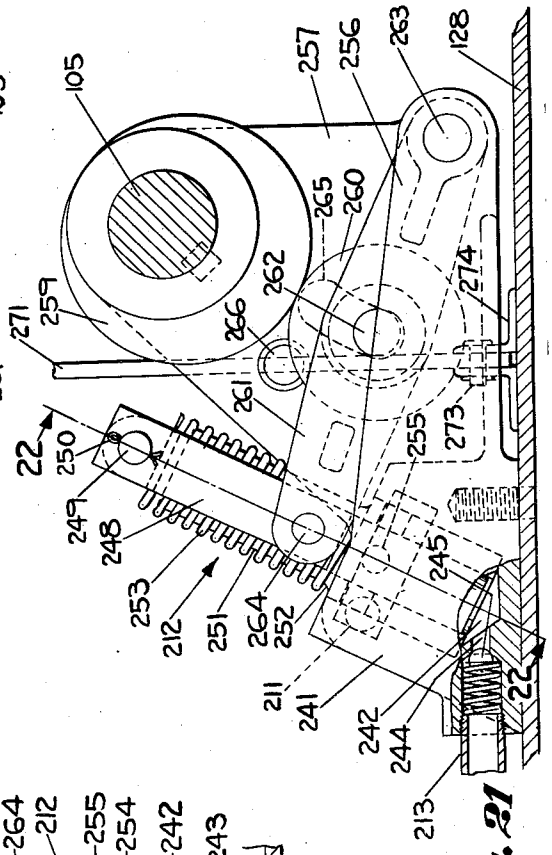



Fig. 21

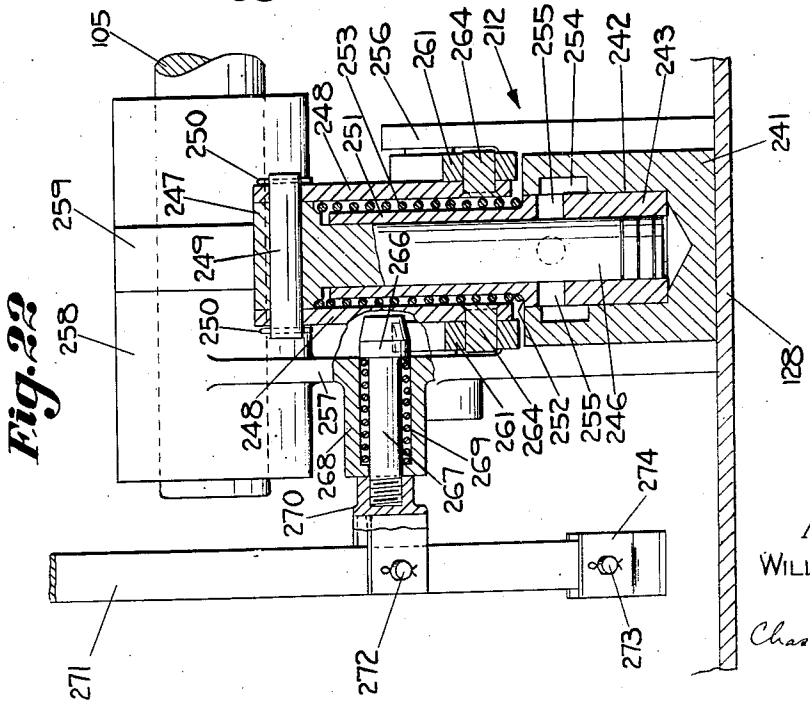



Fig. 22

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SELF-PROPELLING LOADER

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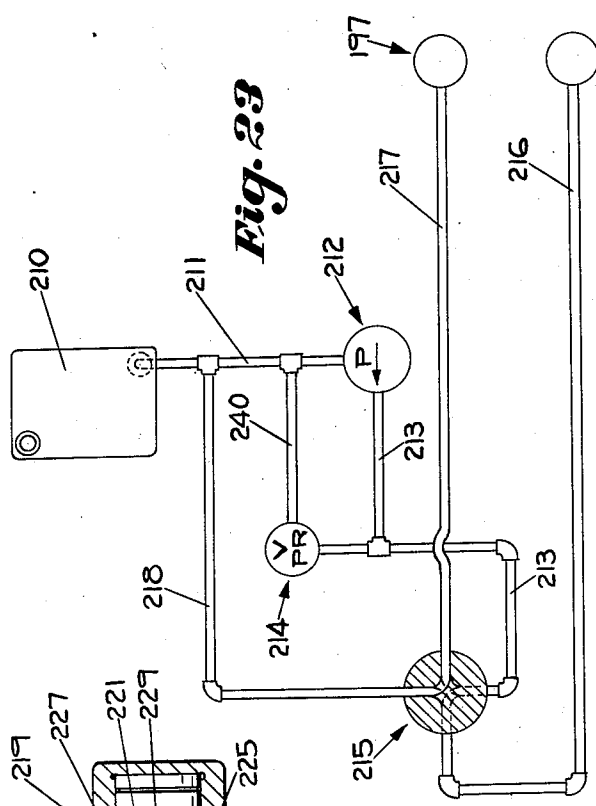



Fig. 23

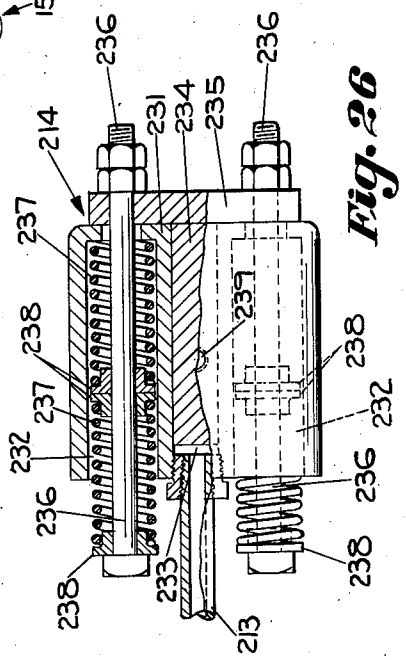



Fig. 26

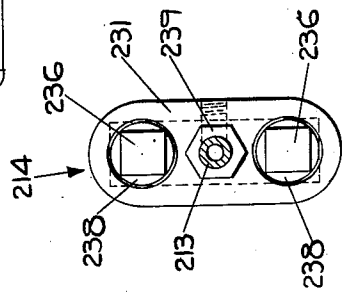



Fig. 27

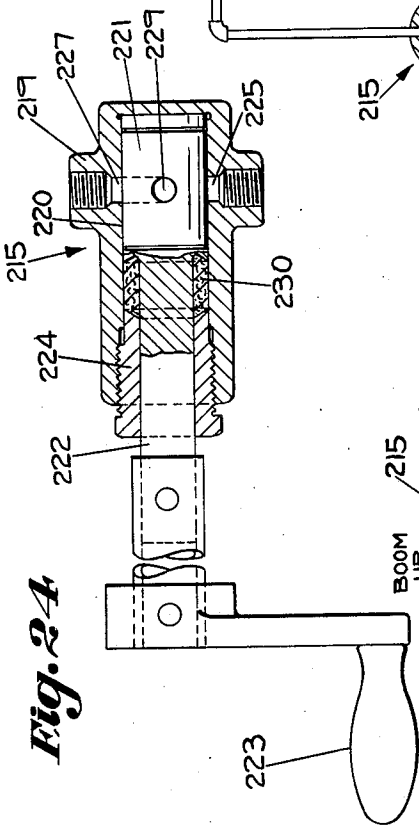



Fig. 24

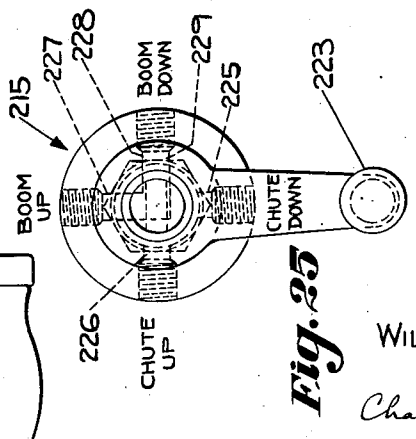



Fig. 25

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Patented Aug. 5, 1941 2,251,667

# UNITED STATES PATENT OFFICE

2,251,667

## SELF-PROPELLING LOADER

William E. Ehinger, Tiffin, Ohio, assignor to The Jeffrey Manufacturing Company, a corporation of Ohio

Application March 19, 1938, Serial No. 196,960

1 Claim. (Cl. 198—121)

This invention relates to a portable loader or conveyor of the self-propelling type which is particularly useful in loading loose material from a storage pile into a truck, as, for example, the loading of coal from a pile in a coal yard into a truck, though the machine is not restricted to this use and may be used to load other material such as gravel, crushed stone, etc.

An object of the invention is to provide a machine of the above type which is very flexible in operation and is very easily controlled to perform the loading operation.

Another object of the invention is to provide safety means to control the downward movement of a boom which is adjusted by a hydraulic piston motor.

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

Fig. 1 is a side elevational view of the apparatus comprising my invention;

Fig. 2 is a front view showing particularly the mast of the loader of my invention;

Fig. 3 is a sectional elevational view taken on the line 3—3 of Fig. 1 looking in the direction of the arrows;

Fig. 4 is a longitudinal sectional view showing the construction of the hydraulic piston motor for adjusting the boom in the device of Fig. 1;

Fig. 5 is a plan view of the frame or strut of the device of Fig. 1 with numerous parts shown in section;

Fig. 6 is an elevational view taken on the line 6—6 of Fig. 5 looking in the direction of the arrows;

Fig. 7 is an enlarged side elevational view of the bottom or foot end of the boom of the device of Fig. 1;

Fig. 8 is a longitudinal sectional elevational view of the structure shown in Fig. 7;

Fig. 9 is a sectional view taken on the line 9—9 of Fig. 7 looking in the direction of the arrows;

Fig. 10 is an enlarged side elevational view of the head or discharge end of the boom showing also the attached chute of the device of Fig. 1 of the drawings;

Fig. 11 is a view taken on the line 11—11 of Fig. 10 looking in the direction of the arrows, with parts of the cylinder shown in section;

Fig. 12 is a sectional view taken on the line 12—12 of Fig. 10 looking in the direction of the arrows;

Fig. 13 is an enlarged side elevational view showing the mounting of the boom on the mast;

Fig. 14 is a view taken on the line 14—14 of Fig. 13 looking in the direction of the arrows with parts broken away to show the structure of one of the bearings;

Fig. 15 is an enlarged detail view showing in elevation the drive means for one of the traction wheels;

Fig. 16 is a sectional view taken on the line 16—16 of Fig. 15 looking in the direction of the arrows;

Fig. 17 is an enlarged plan view of the drive and control mechanism for the traction devices;

Fig. 18 is a sectional and elevational view taken on the line 18—18 of Fig. 17 looking in the direction of the arrows;

Fig. 19 is an enlarged sectional veiw showing the bottom of the hydraulic piston motor for adjusting the boom and a control valve associated therewith;

Fig. 20 is a plan view of an improved hydraulic pump comprising a feature of my invention;

Fig. 21 is a side elevational view of the pump of Fig. 20 with parts shown in section;

Fig. 22 is a sectional view taken on the line 22—22 of Fig. 21 looking in the direction of the arrows;

Fig. 23 is a piping diagram for the hydraulic control system;

Fig. 24 is a sectional view of the control valve of the hydraulic system;

Fig. 25 is an end view of the valve of Fig. 24;

Fig. 26 is a view partly in plan and partly in section of a combined accumulator and pressure relief valve of the hydraulic system; and

Fig. 27 is an end view of the device of Fig. 26.

Referring particularly to Figs. 1, 2 and 5 of the drawings, it will be seen that the portable loader or scraper conveyor comprising my invention includes a main frame or strut 30 formed by a pair of spaced longitudinally extending inner channel members 31, 31 and a pair of spaced outer channel members 32, 32 which, at their rear ends, are spaced apart from the channel members 31, 31 and attached thereto by cross-pieces 33, 33 (see Fig. 2), the forward ends of said outer channel members 32, 32 converging inwardly toward said inner channel members 31, 31 and being attached thereto at their forward ends. At their rear ends the channel members 31, 31 and 32, 32 are provided with upwardly extending brackets 34 between which extend a plurality of pipes 35, 36 and 37. A transverse shaft 38 extends loosely through holes in the brackets 34 and through the aligned pipes 35, 36 and 37 which pipes act as spacers for the channel members 31, 31 and 32, 32. The shaft 38 carries ground engaging

supporting and traction wheels 38 at opposite ends thereof, which wheels 39 act to support one end of the strut or main frame 30 and are employed to propel the loader, as hereinafter described in complete detail.

Extending upwardly from the rear end of the main frame or strut 30 and pivotally attached thereto for free movement about the axis of the shaft 38 is a mast 40 comprising spaced apart longitudinally extending inner channel members 41, 41 and spaced outer channel members 42, 42 (Fig. 2) which are spaced apart from the inner channel members 41, 41 at their bottoms by the spacer pipes 35 and 37, said inner and outer channels 41, 41 and 42, 42 being attached together at their tops. A cross-channel 43 is provided intermediate the top and bottom of said mast 40 to brace the upwardly extending channel members 41, 42.

Pivotally attached to the rear end of the main strut 30 and movable upwardly and downwardly between the inner channel members 41, 41 of the mast 40 is a scraper conveyor mechanism comprising a boom 44 formed by a pair of longitudinally extending upright side plates 45, 45 which are rigidly connected by a plurality of spaced apart intermediate cross-pieces 46 (see Fig. 3) and bottom cross-pieces 47. The side plates 45 are also reinforced by upstanding angle members 48, the bottoms of which are rigidly attached to said cross-pieces 47.

Extending longitudinally through substantially the entire length of the boom 44 and supported upon the cross-pieces 46 in a U-shaped trough or bottom plate 49. The side plates 45, 45 are provided with inwardly extending upper run guideways 50, 50 formed by spaced top and bottom angle plates and lower run guideways 51, 51. Adjacent the top of the boom 44 is a head shaft 52 provided with appropriate chain receiving rollers and adjacent the foot thereof is a similar shaft 53 provided with appropriate chain receiving rollers 54, 54 illustrated in detail in Fig. 9 of the drawings.

A pair of endless conveyor chains 55, 55 extends between the rollers 54, 54 associated with the tail shaft 53 and the similar rollers associated with the head shaft 52 and comprise the draft and guide means of the scraper conveyor mechanism associated with the boom 44 which is completed by a plurality of scraper cross-flights 56 which are rigidly attached to said chains 55, 55.

By reference to Figs. 7, 8 and 9 of the drawings, it will be seen that the foot of the boom 44 is formed by increasing the width of the side plates 45 to provide downwardly extending skirts which house the drive means for the conveyor chains 55, 55, as hereinafter described in complete detail, and also carry a chain tensioning means in the form of a transversely extending shaft 57 carrying a pair of spaced rollers 58 adapted to receive the chains 55, 55, said shaft 57 being carried in elongated slots 59 in said skirts and being adjustable by nut and bolt adjusting means 60.

The bottom edges of said plates 45 at said foot section are connected by an enclosing bottom plate 61 which terminates adjacent a heavy wear plate 62 which also extends between said plates 45, 45 and is located at the bottom-most portion thereof and takes the wear of the lower end of the boom 44 which is adapted to rest upon the ground or material which is being elevated and conveyed. The wear plate 62 terminates adjacent an adjustable blade 63 which has a beveled leading edge 64 and which is pivotally attached to a pair of foot shoes or castings 65 by a transversely extending shaft 66. An operating lever 67 is provided for pivoting the blade 63 about the axis of the shaft 66 and is provided with a detent handle 68 adapted to be received by a selective one of the notches 69 in an arcuate retaining plate 70.

It is evident that by adjusting the lever 67 the blade 63 may be moved up and down about the axis of the shaft 66 to determine the attack of the boom on the material to be loaded. It is also possible to agitate the blade 63 during operation of the loader by releasing the detent and operating the lever 67 up and down. The aforementioned shoes or castings 65 provide a very effective protection means for the two conveyor chains 55 adjacent the foot or material gathering end of the boom 44 and also act to guide said chains as they move around the rollers 54, 54.

Access to the area formed by the above mentioned skirts and side plates 45 is afforded by openings therein, one of which is seen at 71, which openings are closed by removable plates, one of which is seen at 72.

Attention is now directed to Fig. 9 of the drawings, and to the structure of the tail shaft assembly, which structure is similar to the assembly which includes the head shaft 52. As previously set forth, the shaft 53 is stationary and has mounted upon opposite ends, by appropriate journal bearings, the rollers 54 associated with chains 55. The opposite ends of the shaft 53 extend through appropriate openings in the side plates 45 and through plates 73 rigidly attached to said side plates 45 which increase the bearing area for said shaft 53.

The extreme ends of the shaft 53 are also provided with grooves 74 having flat bottoms which lie in the same plane and are adapted to receive retaining plates 75 which are removably attached by machine screws 76 and which operate to hold the shaft 53 rigid with the side plates 45, 45 of the boom and at the same time to prevent rotation thereof.

To form a protection for the shaft 53, it is surrounded with a tube 77 which is supported entirely and directly from the shaft 53 by means of a pair of spaced rings 78 which are tack-welded to said tube 77 and have a press fit with the shaft 53. The extreme ends of the tube 77 have welded thereto guide and protecting plates 79 which have apertures therein into which the hubs of the rollers 54 extend. To permit entirely free rotation of said rollers 54 a relatively small amount of clearance is provided between the plates 79 and said hubs and between the ends of the tube 77 and said hubs where they surround said hubs. As best seen by reference to Fig. 8 of the drawings, the tube 77 is positioned in contact with the trough or bottom plate 49 of the conveyor which is supported at this point by a transversely extending angle member 80.

Attention is now directed particularly to Figs. 1 and 5 of the drawings, and to the drive for the above described conveyor mechanism associated with the boom 44. Mounted upon a platform 81 at the rear end of the main frame or strut 30 is an electric motor 82, though a gasoline motor may be employed if desired. The motor 82 drives a pivot shaft 83 through a small sprocket 84 mounted upon the shaft of said motor 82 and a large sprocket 85 keyed to said pivot shaft 83 which are interconnected by a

relatively short drive chain 86. The close proximity of the motor 82 and the shaft 83 makes for a minimum length of drive chain 86 which is very desirable due to the fact that said drive chain 86 is the highest speed drive chain in the entire driving system and, as is well known, high speed chains tend to wear out and cause more trouble than low speed chains.

The pivot shaft 83 effects the pivotal connection of the forward end of the strut or main frame 30 with the boom 44 and this is consummated by virtue of bearing blocks 87, 87, which are rigidly attached to the side plates 45, 45 and make a pivotal connection with brackets 88, 88 which extend upwardly from the rear ends of channel members 31, 31 and are provided with circular openings adapted to receive said bearing blocks 87, 87.

The hub of the sprocket 85 is provided with a pinion gear 89 which meshes with a large gear 90 carried by a jack shaft 91 in appropriate bearings 92, 92 in the side plates 45, 45. Loosely journaled on the jack shaft 91 is a drive pinion 93 which is controlled by a friction clutch 94 associated with jack shaft 91 and which meshes with a large gear 95 carried by knuckle shaft 96 mounted in bearings 97, 97 carried by side plates 45. The knuckle shaft 96 has keyed thereto a pair of drive sprockets 98 which mesh with the previously described conveyor chains 55 to effect the final drive from the motor 82 to said conveyor chains.

By reference to Fig. 1 of the drawings, it will be seen that the clutch 94 is provided with an operating lever 99 and it is evident that whenever motor 82 is running, the scraper conveyor may be operated to convey material from the foot to the head end of the boom 44 under the control of the operator through said lever 99 and clutch 94. In other words, by engaging said clutch 94 the conveyor will convey material, and by disengaging it the conveyor will remain stationary.

As also seen by reference to Figs. 1, 7 and 8 of the drawings, the chains 55 may be tensioned by the tensioning mechanism including the shaft 57 and the rollers 58 by virtue of their relation to the sprockets 98.

It may also be mentioned that the friction clutch 94 performs as a safety device in that in case of any overload on the conveyor mechanism this clutch will slip, thus preventing the breakage of any parts. The slipping of the clutch would be a signal to the operator that the conveyor is overloaded and the clutch should be disengaged.

It is desirable to operate the machine through the traction wheels 39 from the motor 82 in reverse directions and at different speeds. For example, to effect a crowding of the loader into a pile of material by crowding the foot or receiving end of the boom 44 into the material, it is desirable to feed the machine to the left, as viewed in Fig. 1, by applying power to the tractiton wheels 39. This crowding action should be at a relatively low speed to provide great power. Movement of the loader away from the pile of material under power is also desirable and in the interest of speed and economy of time, this rate of movement should be considerably higher than the rate of crowding movement. I have found a ratio of three to one to be very satisfactory.

It is also desirable to be able to control the traction wheels 39 to swing the loader particularly for movement from one place to another, and to this end the control means for said traction wheels 39 may be operated to apply power to either of the traction wheels 39 selectively and simultaneously to apply a brake to the other one whereby the machine would swing about an upright axis in a relatively short radius.

Attention is now directed particularly to Figs. 5, 17 and 18 of the drawings, and to the driving means for said traction wheels 39. Loosely journaled on the previously described pivot shaft 83 is a sprocket 100 with which is associated a friction clutch 101 controlled by a lever 102 seen in Fig. 1 of the drawings. Extending rearwardly from the sprocket 100 is a chain 103 which is associated with the sprocket 104 keyed to a countershaft 105 journaled in bearings 106, 107 carried on channels 31 and 32, respectively.

Feathered to the countershaft 105 and slidable along the axis thereof is a gear 108 adapted to be slid along said shaft 105 either to mesh with an idler gear 109 (see Fig. 6), which in turn meshes with the gear 110 keyed to a reversing shaft 111, or to mesh with a large gear 112 also keyed to said reversing shaft 111, or to be in a neutral position where it meshes with neither the gear 109 nor the gear 112. It is manifest that when the gear 108 meshes with the gear 109 the shaft 111 will be rotated in one direction at a relatively fast speed and when the gear 108 meshes with the gear 112 the shaft 111 will be rotated in the opposite direction at a relatively low speed. This means provides for the reverse travel of the loader at different speeds, as above set forth.

The operating means for sliding the gear 108 as aforesaid is in the form of a lever 113, seen in Fig. 1 of the drawings, which has a shipper associated with a circumferential groove 114 on the hub of said gear 108.

It may be mentioned that the idler gear 109 is journaled upon a supporting plate 115 which in turn is supported by appropriate journals on the shafts 105 and 111. It may also be mentioned that the lever 113 preferably has associated with it some means to designate and lock it in the neutral, forward and reverse positions of adjustment to which it can be shifted.

Associated with the reversing shaft 111 is a pair of control clutches one for each of the traction wheels 39, 39 and these clutches include means in association therewith so that they are normally both in an engaging position and a single operating lever is provided so that said clutches may be selectively disengaged and simultaneously with the disengagement of any clutch a friction brake mechanism associated with the traction wheel 39 controlled by said clutch is applied.

Attention is now directed particularly to Figs. 5, 17 and 18 of the drawings and to the structure of this control mechanism. The reverse shaft 111 is mounted in journal boxes 116, 116 carried by the channel members 31. Near opposite ends of said shaft 111 and inwardly of said bearing boxes 116 is a pair of similar jaw clutches 117 and 118. Each of said jaw clutches comprises a clutch element or casting 119 having integral teeth 120 meshing with a gear 121 carried upon a propelling shaft 122 carried by journal boxes 123, 123 mounted on channel members 31 and 32. The clutch element 119 is journaled loosely upon the shaft 111 and has jaws 124 adapted to engage the jaws 125 of a cooperating clutch element or casting 126 which is feath-

ered to said shaft 111 slidable therealong. A coil spring 127 abuts the two clutch elements 126 of the jaw clutches 117 and 118 urging them into operating relation with the cooperating clutch elements 119 thereof.

Pivotally mounted upon a bottom plate 128 (see Fig. 18) which is carried by the frame 30 by pivot bolts 129 and brackets 130, 130', is a yoke 131 which terminates in an operating lever 132 to which is attached an operating rod 133 which in turn is controlled by control lever 134 (see Fig. 1) located at an operator's station with all of the other control levers including previously described levers 99, 102 and 113. Associated with each of the clutch elements or castings 126 is a shipper 135 which is pivotally connected to the yoke 131 by straps 136.

It is manifest by reference to Figs. 5 and 17 of the drawings that if the lever 132 is moved laterally, as viewed in these drawings, the clutch element 126 of the clutch 118 will be disengaged while the clutch 117 remains in engaged relation. Movement of the lever 132 in the opposite direction will effect disengagement of the clutch 117 while the clutch 118 remains engaged. When the lever 132 is in the normal position both the clutches 117 and 118 will be in engaged relation.

To provide for the application of a braking action to the propelling shaft 122 whenever the clutch associated therewith is disengaged, thereby to effect a rapid turning of the loader, I associate with each of said shafts 122 a braking mechanism, said mechanism being seen at 137 and 137'. Said mechanisms are of similar construction and the structure thereof can be readily seen by reference to Figs. 17 and 18 of the drawings. As there illustrated, each shaft 122 carries a brake drum 138 with which is associated a brake band 139, adjustably attached at one end to a stationary bolt 140 and attached at the other end to an adjusting bolt 141. The bolt 141 is associated with a pivoted lever 142 pivoted on a shaft 143 which extends between the two braking mechanisms 137 and 137' and is supported from bottom plate 128 by journal boxes 144. The front end of the lever 142 rests upon and is operated by a horizontal arm 145 of a bell crank lever which also includes a vertical arm 146 pivotally attached to the shipper 135 and further includes a cylindrical bearing portion 147 by which it is pivotally mounted, which bearing portion 147 is carried on an appropriate pivot bolt 148 carried by bracket 130' and 149.

It is thus evident that, whenever clutch 118 is operated to a disengaged position thereby to release the normally established drive from reversing shaft 111 to the associated propelling shaft 122, the brake mechanism 137' associated with said clutch 118 will also be operated to restrict or prevent rotation of said shaft 122 while the entire drive from reversing shaft 111 will be effected through clutch 117 to the associated propelling shaft 122.

To provide for the movement of one of the clutch elements or castings 126 while the other remains in its normal position, each of said straps 136 is provided with an elongated aperture through which studs 150 carried by the yoke 131 extend, which studs 150 are provided with appropriate cotter keys to retain the straps 136 in position. These elongated slots, of course, prevent movement of the yoke 131 away from any clutch element 126 from the normal position as illustrated in Fig. 17, but permit said yoke to move toward either of said clutch elements 126. This structure is, of course, necessary to provide for the selective operation of the clutches 117 and 118 by the single yoke 131.

The final drive from the propelling shafts 122 to the traction wheels 39 is effected by sprockets or pinions 151 keyed to said shafts 122 which mesh with teeth 152 (see Figs. 15 and 16) removably attached to the rims of said wheels 39. It is to be particularly noted by reference to Figs. 15 and 16 of the drawings that the teeth 152 are all individual and form a ring gear with the rim of said wheel 39 by being individually attached thereto by rivets 153. This makes for a very inexpensive and easily replaceable gear structure, particularly in view of the fact that should any tooth become worn, broken or damaged, that single tooth may be replaced without requiring the replacing of an entire ring gear as is usual with a common type of cast ring gear construction.

Attention is now directed particularly to Figs. 13 and 14 of the drawings and to the structure of the sliding connection which is effected between the guide mast 40 and the boom 44 and the safety mechanism which limits the downward movement of the boom 44 to relatively short steps. Extending downwardly from the outsides of the side plates 45 is a pair of plates 154, 154 having forward and rearward pairs of aligned apertures 155 adapted to receive selectively a cross shaft 156 received in spacer pipes 157 between which is pivotally attached a block 158 of an extensible hydraulic motor or jack 159, hereinafter described in complete detail.

Attached to the plates 154 are appropriate journal plates 160 which increase the bearing area between said shaft 156 and boom 44. Each end of the shaft 156 receives a machine screw 161 having a washer 162 thereon which screw 161 extends through an elongated aperture 363 in an inner channel member 41 of the mast 40. This structure provides for relative up and down movement of the boom 44 with respect to the mast 40 while at the same time effecting a guiding of said boom by said mast. It is evident that the shaft 156 may extend through either the upper pair or lower pair of aligned apertures 155 to adjust the maximum and minimum heights of the head end of the boom 44.

To provide a safety feature which precludes a falling of the boom 44 I provide a plurality of ledges or detents 163 on the front face of each of the channels 41. Journaled loosely on opposite ends of the shaft 156 between the plates 154 and the channels 41 is a pivoted lever 164 which levers 164 are connected together by a cross shaft 165 to which is attached a coil spring 166 which, in turn, is attached to one of the plates 154. The coil spring 166 tends to rotate the levers 164 in a clockwise direction.

Welded to the outer top portion of each of the levers 164 is a pawl 167 adapted to ride on the front face of a channel 41. It will be evident that the spring 166 will maintain the pawl 167 in contact with said channel 41 and that downward movement of said boom 44 will be impeded whenever a pawl 167 strikes an upstanding detent 163. As a consequence, the maximum distance the boom 44 could fall would be from one detent 163 to the succeeding detent.

To provide for the normal downward movement of said boom 44, as hereinafter described, the pawls 167 may be released by rotating the levers 164 which are connected together by the cross shaft 165, as above described, in a counter-

clockwise direction by an operating rod 168 pivotally attached at one of said pawls 167 and extending to within reach of the operator, as clearly illustrated in Fig. 1 of the drawings, the rod 168 having a handle 169 associated with the end thereof.

It is manifest that the afore-described safety mechanism will automatically return to a safety position whenever released and that it is necessary for the operator to release said safety mechanism whenever the boom is to be lowered any appreciable amount.

As previously set forth, I provide a hydraulic motor or jack 159 for raising and lowering the discharge end of the boom 44 which has been found to be very efficient, particularly due to the ease and smoothness with which it can be operated and adjusted to any desired position in very small steps and can be locked in any desired position of adjustment. This structure furthermore eliminates entirely the necessity for ropes or cables which are liable to break and simplifies very appreciably both the structure of the boom elevating mechanism and the mast which must support it.

Said hydraulic motor or jack 159 comprises a heavy base 170 (see (Fig. 19) which receives a transverse pivot pin 171 carried by a pair of arms 172 (see Fig. 5) welded to the previously described pipe 36 carried by shaft 38. Welded to the base 170 is a main cylinder 173 to the top of which is threaded a sleeve 174 (see Fig. 4) below which is a spacing sleeve 175. Within the main cylinder 173 is a secondary cylinder 176 provided with a piston head 177 and a washer 178. The spacing sleeve 175 insures adequate telescoping of the cylinders 173 and 176 to insure their rigidity against lateral flexing or bending. The head 177 is provided with a central bore 179 to allow the hydraulic fluid under pressure which is introduced into said cylinder 173 to pass into secondary cylinder 176. Associated with the secondary cylinder 176 is a piston rod 180 the upper end of which is rigidly attached to the previously described block 158 (Fig. 14). The rod 180 is provided with a piston head 181 and a washer 182, as shown in Fig. 4.

The previoulsy described base 170 (Fig. 19) for the main cylinder 173 is provided with a fluid inlet port 183 with which is associated a fitting 184 and a ring 185 having a central opening 186 and a plurality of bores 187. Associated with the central opening 186 is a check valve comprising a ball 188 and a compression spring 189. Associated with the fitting 184 is a pressure supply pipe 190 by which hydraulic fluid is supplied to the hydraulic motor or jack 159. Whenever hydraulic fluid is supplied to the pipe 190 liquid will flow through the bores 187 and through the opening 186 and unseat the ball 188 whereby said fluid will flow relatively free through port 183 into the main cylinder 173.

During the first period of application of hydraulic fluid to said main cylinder 173, the secondary cylinder 176 (Fig. 4) will move upwardly in unison with the rod 180 due to the fact that the area of the piston head 177 is greater than the area of the piston head 181. After the secondary cylinder 176 has been moved to the limit of its movement as determined by the spacing sleeve 175, additional application of hydraulic fluid will cause the rod 180 to move with respect to the secondary cylinder 176 whereby the hydraulic jack will progressively expand, the expansion first being through the secondary cylinder 176 and finally through the rod 180. When the hydraulic fluid is drained from the motor or jack 159 a reverse action will take place and the rod 180 will move downwardly to the limit of its stroke in the secondary cylinder 176 after which the secondary cylinder 176 will move downwardly with respect to the main cylinder 173.

Due to this downward movement of the boom 44 during which the hydraulic motor or jack collapses it is desirable that the rate of downward movement be restricted as the force thereon is relatively great due to the weight of the boom 44. This is effected by the check valve including the spring 189 (Fig. 19) and ball 188 which operate to close the opening 186 in response to a flow of fluid from the main cylinder 173. As a consequence, the hydraulic liquid is required to flow from said cylinder 173 only through the restricted bores 187 which, due to their small area, limit the speed of downward movement of said boom 44. Furthermore, as above set forth, should anything break in connection with the hydraulic motor or jack 159 which would tend to drop the boom 44 this would be prevented by the safety mechanism above described, including the detents 163 and pawls 167.

Adjacent to the top or discharge end of the boom 44 there is provided an adjustable chute 191 which is very flexibly and easily controlled along with the hydraulic motor or jack 159 for adjusting the elevation of the head or discharge end of boom 44 by means of a hydraulic system hereinafter described in detail. The chute 191 is essentially of standard construction and is pivotally attached, as illustrated in Fig. 10 of the drawings, by angle members 192 to brackets 193 carried on the bottom of the boom 44. Said chute 191 includes a forward screen section at 194 which discharges into an adjustable slack chute 195 pivotally attached to said chute 191 and carried by chains 196.

Novel means are provided, however, for the aforementioned adjustment of said chute 191 and comprise a hydraulic piston motor 197 comprising a cylinder 198 attached to a plate 199 which, in turn, is supported by appropriate forward angle members 48 and cross-angle members 208. Within the cylinder 198 is a piston 200 to which is attached a piston rod 201 having a head 202 attached to a pair of operating links 203, 203 by a pivot bolt 204. The opposite ends of the links 203 are pivotally attached to a drawbar 205 formed by a pair of spaced angle members and attaching cross-angles, which drawbar in turn is pivotally attached to said chute 191 on opposite sides thereof at 206. Appropriate pins 207, 207 are provided to effect the pivotal connection between the drawbar 205 and the links 203.

As piston 200 is adjusted, links 203 slide on the wings of an attaching bracket for the forward end of cylinder 198 against which they are forced by the weight of chute 191 acting through drawbar 205.

As hereinafter described in full detail, the hydraulic piston motor 197 is controlled by a valve adjacent the operator's position which valve also controls the previously described hydraulic jack or motor 159 thereby providing for the ready adjustment of both the boom 44 and the chute 191 by an operator without requiring his leaving his normal operating station and which adjustment can be effected to a large plurality

of desirable positions in a very easy and highly efficient manner.

Attention is now directed to Fig. 23 of the drawings, which illustrates diagrammatically the hydraulic system for controlling the boom 44 and the chute 191. Said system includes a tank 210 which, as seen in Fig. 5 of the drawings, is supported on a channel member 31, which tank 210 acts as a reservoir for the hydraulic fluid. A feed pipe 211 leads from the bottom of said tank 210 to a pump 212 from which leads a pressure pipe 213. The pump 212 is preferably of a special structure comprising a feature of my invention which is hereinafter described in full detail.

Connected between the feed pipe 211 and the pressure pipe 213 is a combination accumulator and pressure relief valve 214 hereinafter described in full detail. The pressure pipe 213 leads to a common control valve 215, hereinafter described in full detail, which has four positions of adjustment to control separately and individually the expansion and contraction of the hydraulic jack or motor 159 and the expansion or contraction of the hydraulic motor 197. From said control valve 215 a feed pipe 216 leads to the hydraulic motor or jack 159 and another feed pipe 217 leads to the hydraulic motor 197. A return flow pipe 218 also leads from the control valve 215 to the tank 210 by way of pipe 211.

The structure of the control valve 215, is disclosed in Figs. 24 and 25 of the drawings, and comprises a casing 219 having a cylindrical bore 220 within which is rotatably mounted a cylinder or valve element 221 having an operating shaft 222 adapted to receive an operating handle 223. A threaded journal sleeve and packing gland 224 provides a bearing for the shaft 222 and is threaded into the casing 219, and is adapted to press against packing 230 to provide a seal for the cylinder 221. Said casing 219 is provided with four ports 225, 226, 227 and 228 which are connected with the pipes 213, 216, 218 and 217, respectively. The cylinder or valve element 221 is provided with a bore 229 having openings substantially ninety degrees apart to align selectively with pairs of the ports 225, 226, 227 and 228 or to be positioned intermediate any two of said ports.

By reference to Figs. 23 and 25 of the drawings, it is to be noted that the handle 223 of said control valve 215 has four operating positions. In the position marked "Chute down" the valve 215 will connect ports 228 and 227 through bore 229 as shown in the full line position in Fig. 23, to allow fluid in the hydraulic piston motor 197 to flow freely into the tank 210 thereby to allow chute 191 to move downwardly. By rotating the handle 223 in a clockwise direction through ninety degrees to the position designated "Chute up," ports 228 and 225 are connected by way of bore 229 whereupon hydraulic piston motor 197 is connected to the pressure pipe 213 and the chute 191 will be elevated. Further rotation of the handle 223 ninety degrees to the position marked "Boom up" connects ports 225 and 226 by way of bore 229 whereby pressure pipe 213 is connected with hydraulic jack or piston motor 159 to elevate the boom 44. Still further rotation of the handle 223 through ninety degrees to the position designated "Boom down" connects the ports 226 and 227 by way of bore 229 thereby connecting hydraulic piston motor or jack 159 with the return flow pipe 218 to provide for downward movement of the boom 44.

It is furthermore to be noted that the handle 223 may be positioned substantially intermediate any one of the four above mentioned positions and when in any of said positions of adjustment the bore 229 will not afford communication between any two of the ports 225, 226, 227 or 228, as a consequence of which the hydraulic piston motor 197 and the hydraulic piston motor or jack 159 are locked in their position of adjustment. It is thus evident that a single control valve has been provided to control the operation of the entire hydraulic system including the two hydraulic motors 159 and 197 both to expand and contract them entirely independently and to lock either one or both of them in adjusted position.

By reference to Fig. 1 of the drawings, it is also to be noted that the control handle 223 for the valve 215 is located at the operator's position so that the hydraulic system may be controlled to adjust either the boom 44 or the chute 191 or both of them without requiring the operator to leave his operating station. This, of course, makes for great flexibility and ease of operation of the loader.

Attention is now directed particularly to Figs. 26 and 27 of the drawings, showing the construction of the combined accumulator and pressure relief valve 214 which, for brevity, will be referred to hereinafter as an accumulator. Said accumulator comprises a main body or casting 231 having top and bottom spring receiving bores 232, 232 and a central piston receiving bore 233. Within the bore 233 is a piston 234 attached at its rear end to a cross-head 235 carrying similar elongated upper and lower bolts 236 with which are associated composite coil springs 237 provided with head and intermediate seats 238, the intermediate seats 238 being employed to reduce the necessary length of the coil springs 237. It is evident that the two composite coil springs 237 urge the piston 234 to the left, as viewed in Fig. 26 of the drawings.

Communicating with the left-hand end of the bore 233 is the pressure pipe 213. It is thus evident that the pressure in said pipe 213 will be transmitted to the bore 233 and will urge said piston 234 to the right, as viewed in Fig. 26 of the drawings, against the action of the springs 237.

As hereinafter described, the pump 212 is of the reciprocating type which means that the hydraulic pressure supplied thereby to pressure pipe 213 will be of a pulsating character. The accumulator 214 will smooth out these pulsations due to the fact that piston 234 will move to the right under each pulsation and store energy in the coil springs 237 which will thereby urge the piston 234 to the left as the pressure of each individual pulsation is reduced, thus making the pressure in said line 213 much more even or smooth than it would normally be.

The accumulator 214 also acts as a pressure relief valve by virtue of the fact that a port 239 leads to the bore 233 substantially intermediate the ends thereof and whenever the pressure in line 213 is sufficient to move the cylinder 234 to the right, as viewed in Fig. 26, a sufficient amount to uncover said port 239 a by-pass circuit will be provided from the pressure pipe 213 to the feed pipe 211 because said port 239 is connected to said pipe 211 by a branch pipe 240, as clearly illustrated in Fig. 23 of the drawings.

Attention is now directed to Figs. 5, 20, 21 and

22 and to the structure of the pump 212. Said pump 212 comprises a main casting 241 which is supported on the bottom plate 128 and is provided with a cylindrical bore 242 which receives a removable cylinder 243. The bottom of the bore 242 has communication by way of port 244 with the pressure pipe 213, the port 244 being controlled by check valve 245 which permits fluid to flow from said bore 242 to said pressure pipe 213 but prevents flow in a reverse direction. Reciprocally mounted within the cylinder 243 is a piston 246 having a head 247 pivotally attached to straps 248 by means of pin 249 held in place by removable cotter keys 250. The cylinder 242 is provided with an elongated neck portion 251 which, due to its decreased exterior diameter, provides a shoulder 252 against which abuts a coil spring 253 which abuts the head 247 at its opposite end. This spring performs the double function of maintaining the cylinder 243 seated in the bore 242 and urging the piston 246 out of said cylinder 243.

The pump 212 is not provided with a check valve on the intake side but in lieu thereof I provide a circumferential chamber 254 in the main casting 241 which communicates with four radial ports 255 in the cylinder 243 and positioned so that said ports 255 communicate with the interior of said cylinder 243 when the piston 246 reaches the upper or outer extremity of its stroke. The chamber 254 is connected with the feed pipe 211 whereby the hydraulic fluid will be supplied to said pump 212 from the reservoir 210.

The main casting 241 is provided with a pair of integral rearwardly extending arms 256 and 257 the latter of which is considerably larger than the former and extends upwardly and is provided at its upper end with a journal bearing 258 which supports one end of the countershaft 105 which drives said pump 212, as clearly illustrated in Fig. 5 of the drawings. Keyed to said countershaft 105 is an eccentric 259 which rides on a roller 260 carried between spaced arms 261, 261 by a pin 262, which spaced arms 261 are pivotally attached at their lower rear ends by a cross-pin 263 to the rearwardly extending arms 256 and 257 of the main casting 241 and are pivotally attached at their forward ends by pins 264, 264 to the straps 248, 248. The arm 257 is also preferably provided with an elongated arcuate opening 265 with which the pin 262 is always in alignment to permit ready removal of said pin.

From the above description of the construction of the pump 212 it is manifest that whenever countershaft 105 rotates the eccentric 259 will rotate on the roller 260 which will cause reciprocal movement of the arms 261 about the axis of pin 263 which reciprocal movement will be transmitted to the piston 246 by way of straps 248 and head 247. This movement of the piston 247 is positive in one direction which is in the direction of pressure creation and is non-positive in the opposite direction under the influence of the coil spring 253.

In order to prevent reciprocation of the piston 246 with the consequent building up of pressure in the hydraulic system for no useful purpose when neither of the hydraulic piston motors 159 or 197 is in operation, I provide means constructed normally to maintain the piston 253 in the position illustrated in Figs. 21 and 22 of the drawings in which the coil spring 253 is compressed which provides for free rotation of the eccentric 259. In other words, I prevent the roller 260 following the cam 259 except when hydraulic fluid under pressure is desired for a useful purpose. To this end I provide a detent 266 which has a tapered nose and is adapted to engage one of the arms 261 and prevent return movement of it, thereby holding the piston 246 in its extreme downward position.

The detent 266 is provided with a shank 267 which extends through a bored boss 268 formed integral with the arm 257 and containing a coil spring 269 which presses on the detent 266 urging it into a position to hold one of the arms 261 in a locked non-operating position, as above described. The shank 267 is provided with a removable head 270 which limits the movement of the detent 266 under the influence of the spring 269. The head 270 is bifurcated to receive an operating lever 271 which is pivotally attached thereto by a pin 272 the bottom of which lever 271 is pivotally attached by a pin 273 to a bracket 274 mounted upon the bottom plate 128.

The lever 271 is positioned adjacent to the other operating levers at the operator's position, as clearly illustrated in Fig. 1 of the drawings. It is manifest that whenever the lever 271 is in its normal released position the detent 266 will engage one of the arms 261 and hold the pump 212 in a non-operating position. Whenever it is desired to operate either of the piston motors 159 or 197 the lever 271 will be moved to the left, as viewed in Fig. 22 of the drawings, whereupon the pump 212 will be brought into operation to create the necessary fluid pressure.

In addition to the structure which has previously been described, it may be mentioned that the main frame or strut 30 is provided with a removable cover 275 (see Fig. 1) to protect the operating mechanism mounted thereon. The cover 275 is provided with appropriate apertures through which the operating levers 102, 113, 134, 223 and 271 extend.

To start the machine for operation the clutches 94 and 101 (see Fig. 5) should be in a disengaged position and the gear shift lever 113 should be in the neutral position. The motor 82 is then started. To put the conveyor mechanism in operation the lever 99 is operated to control the friction clutch 94 which, as above set forth, acts as a safety device in case of an overload, by slipping.

To crowd the lowered gathering or foot end of the boom 44 into a pile of material thereby to load said material the lever 113 is operated to engage the gears 108 and 112 which, as above set forth, effects a low speed feeding drive of the loader in the left-hand direction, as viewed in Fig. 1 of the drawings. Thereafter, lever 102 is operated to engage clutch 101 which controls the completion of the drive from the motor 82 to the traction wheels 39 to effect the above mentioned crowding action.

To reverse the direction of movement of the loader away from the pile of material, the clutch 101 is disengaged by the operation of lever 102 and the gear shift lever 113 is moved to reverse position in which gears 108 and 109 are in mesh whereupon the clutch 101 is again operated to an engaged position.

Should it be desirable to swing the machine when operating either in a crowding operation or a reverse operation it is only necessary to operate the control lever 134 which is effective to disengage the drive to one of the traction

wheels 39 and simultaneously to apply the brake thereto. It is manifest that reverse swinging movement of the loader can be effected by a reverse movement of the control lever 134.

To raise the boom 44 or the chute 191 it is first necessary that the machine be stationary and that the gear shift lever 113 be in neutral position. With this condition the handle 223 for the control valve 215 is moved to the desired position of adjustment such as "Boom up" or "Chute up," whereupon clutch lever 102 is operated to engage clutch 101. This will cause rotation of the countershaft 105 but pressure will not yet be available until lever 271 is operated to release the detent 266 and place the pump 212 into operation. The prescribed operation will then take place until the lever 271 is released which will automatically render the pump 212 non-operating. To lower the boom 44 or the chute 191 all that is necessary is to move the handle 223 of control valve 215 to the proper designated position.

Whenever said handle 223 is in any intermediate position between the four operating positions, as above set forth, both the hydraulic jack or piston motor 159 and the hydraulic piston motor 197 will be locked in adjusted position.

It is manifest that the portable loader is extremely flexible in that practically any adjustment thereof can be effected by the operator from his normal operating station and that a minimum of effort is required to effect a wide range of adjustments and movement of the machine either for transportation from one pile of material, such as coal, to another, or for operating on a pile of coal or loading it into a truck.

It is furthermore to be noted that there is a minimum of wear on the elements of the hydraulic control system because the pump 212 is rendered inoperative except when it is required to do useful work. This eliminates entirely the circulation of hydraulic fluid, such as oil, for no useful purpose, and increases the life of the oil as well as the life of the equipment.

Furthermore, the safety feature for the boom 44 insures against the boom falling, as the downward movement thereof is restricted to very short distances by the detents 163 and pawls 167. It may be stated that whenever a pawl 167 rests on a detent 163 it is usually necessary to elevate the boom a slight amount by the hydraulic jack or piston motor 159 to release said pawls 167 from said detents 163.

Furthermore, by reference to Fig. 1 of the drawings, it is to be noted that the top of the mast 40 is in a position substantially always below the boom 44 except when the boom is in its lowermost position, which even then, due to the curved path of travel of the mast top, is only slightly above the top of the boom, as illustrated in dotted lines. The loader is thus free to pass under low head structures.

Certain other features herein disclosed are also disclosed and claimed in my application for a Self-propelling loader, Serial No. 196,961, filed March 19, 1938. This includes particularly the truck propelling control mechanism and the elements which go to make up this propelling mechanism as well as the drive mechanism for the scraper conveyor and the propelling mechanism.

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 claim 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:

In a portable loader, the combination with a frame, of a boom connected thereto, a mast for guiding said boom for up and down adjustment relative thereto, means for adjusting the boom relative to said mast, releasable latch mechanism between the boom and the mast for enabling said boom to be supported on said mast, and manually operable mechanism extending along said boom from said latch mechanism to enable the operator to release said latch mechanism preparatory to the lowering of said boom by control of said boom adjusting means.

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