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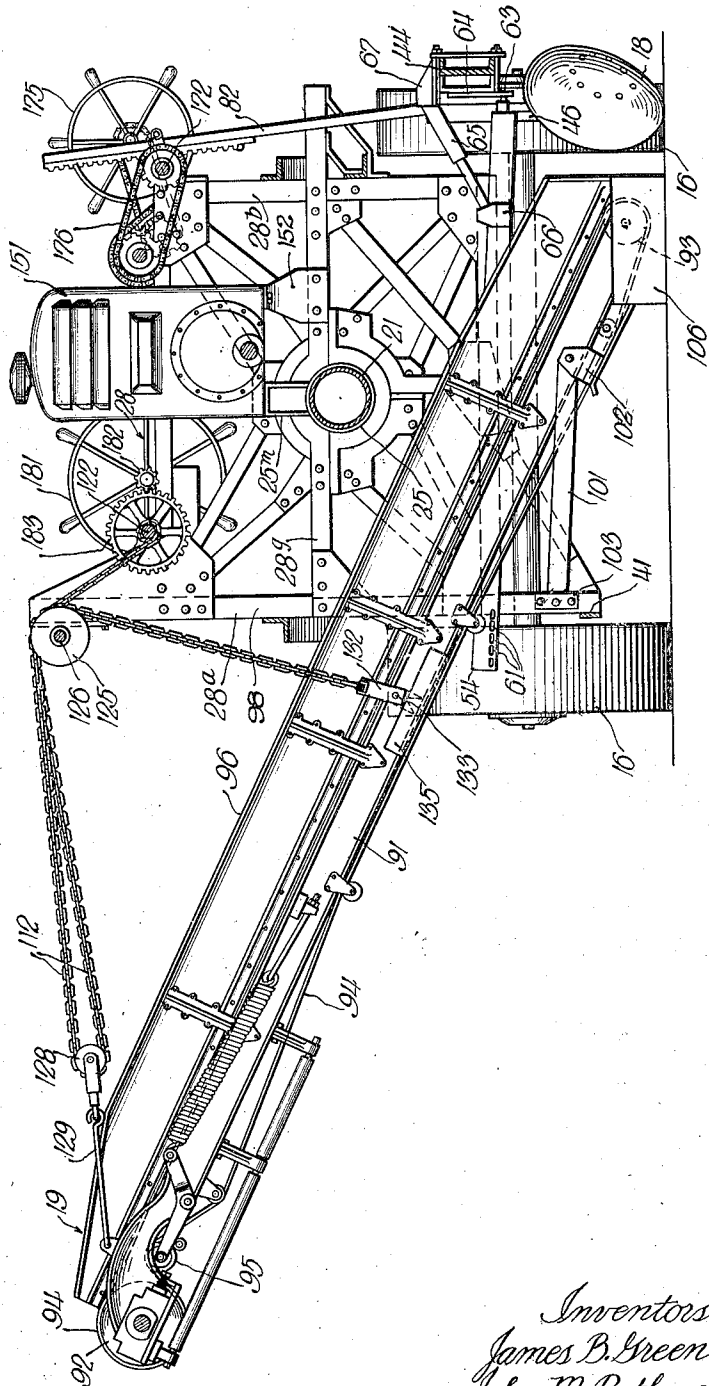
J. B. GREEN ET AL

2,045,387

ELEVATING GRADER

Original Filed April 6, 1932

5 Sheets-Sheet 2



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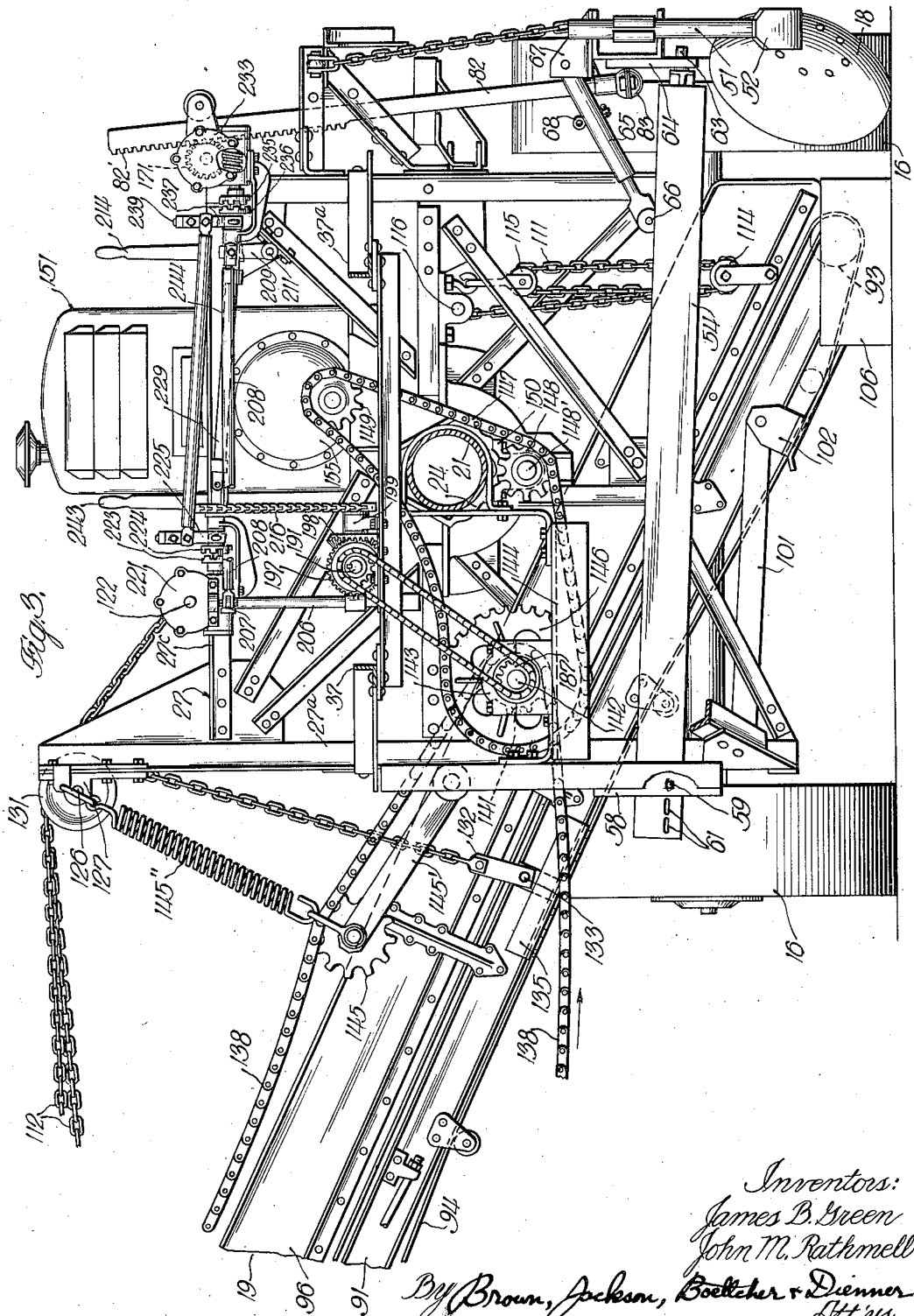
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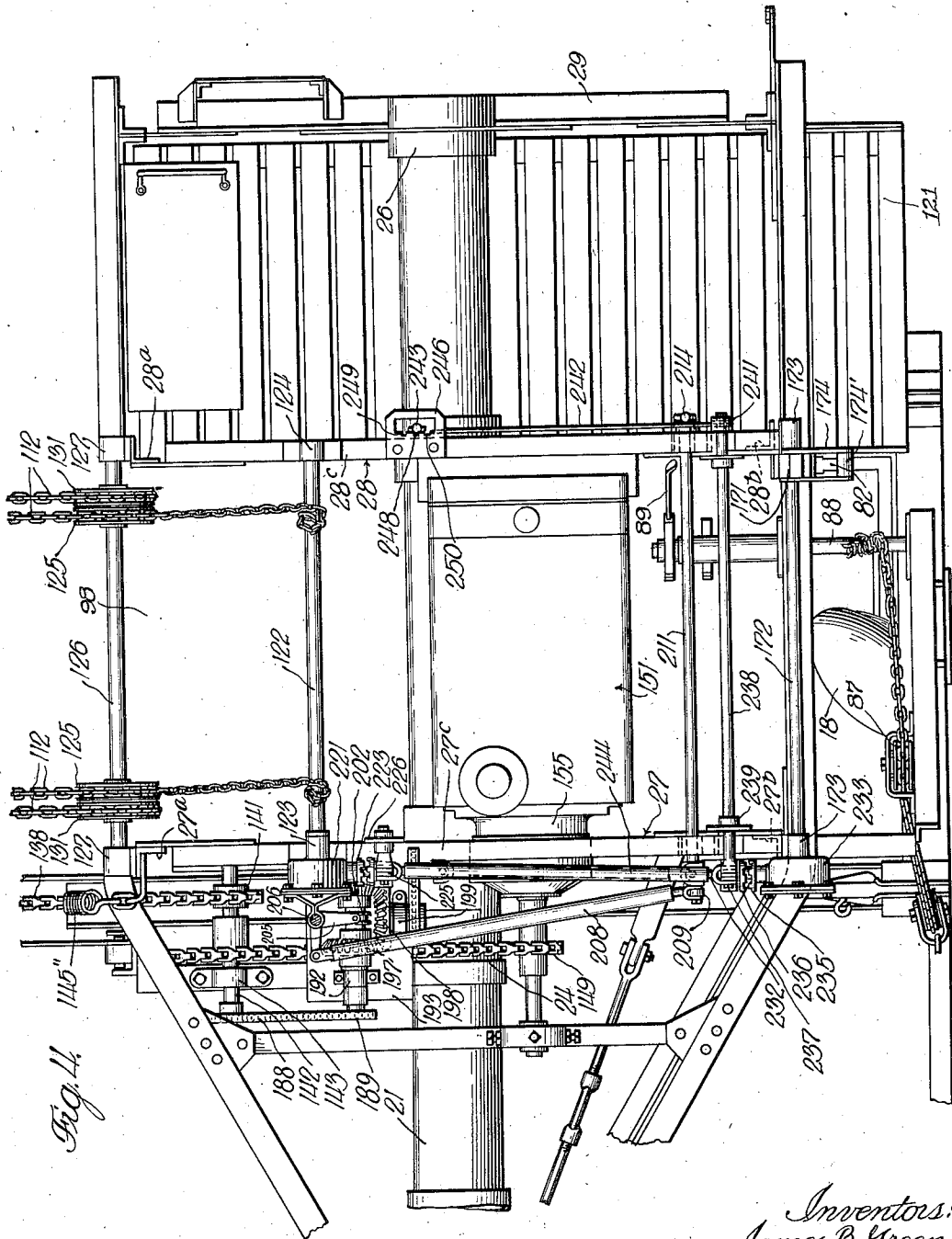
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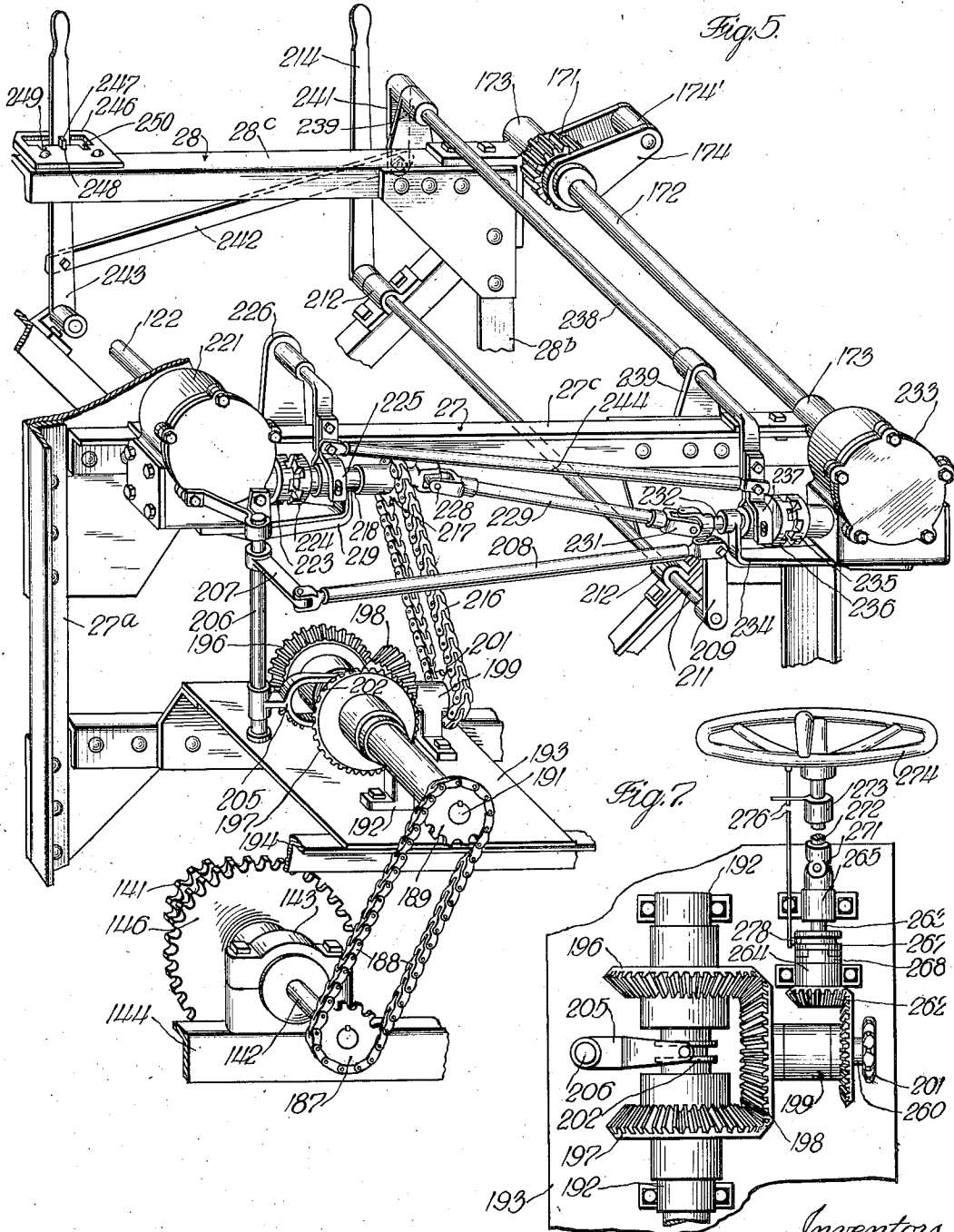
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## UNITED STATES PATENT OFFICE

2,045,387

## ELEVATING GRADER

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Original application April 6, 1932, Serial No. 603,460. Patent No. 1,981,170. Divided and this application March 10, 1933, Serial No. 660,196

17 Claims. (Cl. 37-110)

The present invention relates to elevating graders which excavate or plow up the soil and elevate it for dumping into wagons or trucks traveling alongside or in proximity to the grading machine. These machines are extensively used in grading a roadway preparatory to paving a road or street, and are used in other like excavating operations. The two fundamental elements of such a machine are the grading plow which breaks and turns up the soil, and the elevator which receives this soil from the plow and elevates it up to a delivery point where the soil is discharged into a wagon or truck traveling adjacent to the grader.

The present application is divisional of our Patent No. 1,981,170, and is concerned primarily with the improved power actuated adjusting means which was disclosed in that application for adjusting the grading plow and for adjusting the elevator.

One of the objects of the invention is to provide improved power actuated means for vertically adjusting the position of the grading plow. Another object of the invention is to provide improved power actuated means for vertically adjusting the discharging height of the outer end of the elevator. In the case of the ordinary manually actuated mechanism for raising and lowering the plow and the elevator, it requires considerable exertion on the part of the operator to raise and lower these devices, particularly to raise or lower the plow for rapidly obtaining a different plowing depth or for enabling the plow to clear obstructions during the continued forward travel of the machine. With regard to the elevator, it has a considerable projecting length, and because of the weight of this overhanging end and the weight of the load of soil being carried on the elevator, it has heretofore required considerable exertion on the part of the operator to raise the elevator by the ordinary manually actuated mechanism, and such adjusting actuation has been relatively slow. The present improved power actuated mechanism avoids this exertion and relatively slow operation, in both the case of the plow and of the elevator, by providing mechanism which is operative to raise or lower either the plow or the elevator by the quick, simple manipulation of suitable clutch and directional controls.

Another object of the invention is to provide an improved construction of elevating grader which can be quickly and easily converted from a type wherein all power for driving the aforesaid power actuated adjusting mechanism and for driving

the elevator belt is derived from an engine mounted directly on the grader, to a type wherein this power for actuating the adjusting mechanism and the elevator belt is derived from a take-off attachment transmitting power through a rotating shaft from the tractor or other pulling vehicle to the grader.

Another object of the invention is to provide improved adjusting mechanism which can be optionally operated either by power or manually, the manual mode of operation taking care of possible contingencies when the power source might be non-operating or disconnected.

Another object of the invention is to provide improved manually actuated adjusting mechanism for the plow and elevator.

Other objects and advantages of the invention will appear in the following detail description of a preferred embodiment thereof. In the accompanying drawings illustrating such embodiment:

Figure 1 is a perspective view of the complete construction of one form of our invention;

Figure 2 is a transverse sectional view through this form of construction, taken on a plane just forward of the elevator;

Figure 3 is a transverse sectional view taken on a plane through the forward portion of the frame, illustrating the same general construction as Figures 1 and 2 except that it is modified by the provision of the power actuated mechanism for raising and lowering the plow and the elevator;

Figure 4 is a fragmentary plan view illustrating the principal parts of the power actuated mechanism for adjusting the plow and the elevator;

Figure 5 is a schematic perspective view illustrating the driving and control connections used in the power actuated mechanism for adjusting the plow and for adjusting the elevator;

Figure 6 is a longitudinal detail sectional view through the power take-off connections employed when take-off power is transmitted from the tractor to the grader; and

Figure 7 is a fragmentary detail view of a modified construction wherein the adjusting mechanism for the plow and for the elevator can be actuated selectively either by power or manually.

Referring to Figure 1, the machine comprises a main frame, designated 14 in its entirety, which is mounted on front wheels 15 and rear wheels 16. In the preferred construction shown, the machine is of the tractor pulled type, such being desirable for large capacity operation, and in such con-

struction the front wheels 15 are mounted on a swinging truck 17 adapted for draft attachment to the tractor; however, it will be understood from the following description, that numerous features of our invention are also capable of embodiment in self-propelled graders wherein the propelling engine is mounted directly on the grader, and in constructions where the front wheels 15 have swiveled steering knuckle mounting on a front axle. The grading plow is generally indicated at 18 and the elevator is indicated at 19, the plow being disposed at one side of the frame 14, and the major length of the elevator projecting laterally from the other side of the frame. In the preferred construction the discharging end of the elevator apparatus is disposed laterally of the frame for side loading, although it will be understood that certain features of our invention are also applicable to elevating graders of the type wherein the elevator apparatus is arranged for end loading into a vehicle in front or in rear of the grader.

The detail construction of the main frame 14 is fully described in our aforementioned patent, No. 1,981,170, and accordingly in the present specification we shall only describe the main elements of the frame, reference being had to the parent application for the detail elements of the construction. The backbone of the frame comprises a torque tube 21 preferably consisting of a length of heavy steel tube or cylindrical pipe extending substantially from end to end of the frame and disposed substantially medially between the sides of the frame. Rigidly secured to the front end of said tube is a J-shaped steel member 22 which extends downwardly and forwardly for supporting a king pin 23 which establishes a ball and socket joint 23a with the front wheel truck 17. Rigidly secured to said tube at different points back along its length are three brackets or attachment fins 24, 25 and 26 (see Figures 1, 2 and 4). Radiating from these attachment brackets 24, 25 and 26, respectively, are the transverse frame structures 27, 28 and 29. The front and intermediate transverse frame structures 27 and 28 are quite similar in that they each comprise relatively long vertical frame bars 27a, 28a at the right hand side, relatively short vertical bars 27b, 28b at the left hand side, and transverse top bars 27c, 28c extending between said vertical bars. Suitable diagonal bars have their inner ends rigidly secured to the attachment brackets or fins 24 and 25, and radiate outwardly for attachment at their outer ends to the above described vertical and horizontal bars of the frame structures 27 and 28. The rear transverse frame structure 29 comprises a suitable rectangular arrangement of frame bars having attachment to the rear bracket 26 mounted on the torque tube 21. The rear axle 31, preferably a dead axle, on which the rear wheels 16 are journaled, is suitably bolted to the underside of this rear transverse frame 29. It will be seen from the foregoing that each of the three frames 27, 28 and 29 is rigidly reenforced against vertically acting stresses by the torque tube 21.

All three frames, 27, 28 and 29, are preferably tied together and to the front end of the torque tube 21 by longitudinally extending side bars 37, 37a. The intermediate portions of said side bars are suitably secured to the frame structures 27 and 28, and the forward portions of said bars converge together for attachment to a bracket 38 which is suitably secured to a front attaching flange 22b on the front casting 22. The rear ends

of said side bars are bent downwardly for attachment to the upper corners of the rear frame structure 29. As previously remarked, the pin 23 mounted in the lower end of the front casting 22 has a ball 23a at its lower end which seats in a spherical socket provided in the transverse axle portion 17a of the front truck 17, whereby all steering movement occurs around this ball and socket joint, as well as transverse rocking movement of the truck relatively to the frame. It will therefore be seen that the main frame, and its torque tube 21, has a three-point support, one point at the aforesaid ball and socket joint and the other two points at the rear wheels 16, 16.

The plow 18 may be of the disk or of the mold-board type, the disk type being preferred, however. The plow is adjustably supported on a plow beam 44 which in turn is also adjustably carried by the main frame. The disk element is mounted on a bracket 45, relatively to which the disk can be rotatably adjusted for presenting new cutting edges to the ground, and the bracket 45 is secured to a bar 46 depending from the draft beam 44. A diagonal brace bar 47 extends from the lower end of the vertical bar 46 up to a bracket 48 secured to the rear end of the plow beam. Said vertical bar 46 has adjustable connection with the plow beam 44 for enabling the plow to be adjusted forwardly or rearwardly along the length of the beam, the diagonal brace bar 47 having its point of connection to the bracket 48 also correspondingly adjustable forwardly or rearwardly. The lower end of the diagonal brace bar 47 is connected with the lower portion of the plow supporting bar 46 by a shearable pin or bolt 49 of predetermined size. In the event of the plow striking some immovable obstruction this pin or bolt 49 will shear, allowing the plow and its supporting arm 46 to swing back for clearing the obstruction. Adjustably secured to the forward end of the plow beam 44 is a vertical standard 51 carrying a runner or deflecting shoe 52 at its lower end. This runner functions as a deflector for enabling the plow to pass over large obstructions, and may also be used as a gauge element for maintaining a desired depth of grading cut by the plow. The outside tread widths of the wheels 15, 16 are preferably such as to cause the adjacent front wheel 15 to run in the furrow or graded level made by the previous trip of the machine and to cause the adjacent rear wheel 16 to run in the new furrow or graded level directly behind the plow 18.

The lateral position of the plow beam 44 is maintained by two transversely extending beams 54 which have operative connection with the plow beam at points forwardly and rearwardly of the plow. Fig. 3 illustrates the forward one of these transverse beams, both of which extend across the width of the frame and have their 60 further ends pivotally mounted on horizontal pivot pins or bolts 59 which are mounted at the righthand sides of the frame structures 27 and 28. Each of these frame structures carries a pair of spaced angle bars 53 and the pivot pins 59 extend between said angle bars, being removably mounted therein. The transverse beams 54 pass through the spaces between the respective pairs of angle bars and are provided with spaced holes 61 for receiving the pivot pins 59. The 70 beams can tilt up and down around said pins, and by relocating the pins in different ones of the holes 61 the beams can be shifted inwardly or outwardly for adjusting the transverse position of the plow beam 44 and plow with respect 75

to the side of the frame. Referring to Figure 3, the connection between each transverse beam 54 and the longitudinal plow beam 44 is preferably established by a pin 63 projecting from the end of the transverse beam and passing through an apertured lug 64 extending down from the plow beam; and also by an extensible and contractible link 65 comprising inner and outer telescoping link sections, the lower link section being pivotally connected to a bracket 66 projecting from the transverse beam and the upper link section being pivoted to a bracket 67 secured to the top of the longitudinal plow beam 44. A pin 68 may be employed to secure the two link sections in any linear adjustment for the purpose of inclining the plow beam 44 at any desired angle relatively to the transverse beams 54, the mounting of the apertured lug 64 on the pin 63 affording sufficient play to accommodate such rocking movement. The connection of the plow beam to the rear transverse beam 54 is substantially a duplication of that just described.

Draft force is transmitted to the plow mounting parts by a draft link 71 which has a clevis 72 at its rear end pivotally connected to a stirrup 73 which in turn is pivotally connected with the front transverse beam 54. The front end of the draft link 71 has a clevis like the clevis 72 which is pivotally connected with a diagonal bracket 75 rigidly secured to the J-shaped front casting 22. A turnbuckle 76 in the link 71 enables the length of this link to be adjusted. Such draft connection does not interfere with the lowering and elevating movement of the plow beam 44 and transverse beams 54.

The vertical position of the plow 18 is governed by front and rear adjusting connections 81 and 82 (Fig. 1) which have operative connection with the plow beam 44 at points forwardly and rearwardly of the plow. The rear connection 82 preferably consists of a bar or link having a ball and socket connection 83 with a bracket fixture projecting inwardly from the rear portion of the plow beam. This rear bar 82 functions as a stiff leg through which the plow can be raised or through which pressure can be forcibly exerted downwardly on the plow for forcing it into the ground. It is through this stiff leg 82 that the power actuated adjusting mechanism operates for raising and lowering the plow, as we shall hereinafter describe. The adjustable front connection 81 may likewise comprise a stiff member, but in the preferred construction it comprises a chain looping down around a sheave 85 which has its clevis pivoted to the plow beam 44. One end of this chain loop has fixed attachment to a frame structure 86 comprising three bars projecting out over the beam. The other end of said chain passes upwardly over a sheave 87 (Figure 4) on said frame structure 86 and thence extends backwardly for winding about a transverse shaft 88. Said shaft may be arranged to rotate in one direction or the other for raising or lowering the front portion of the plow beam 44 under the control of mechanism such as a worm and worm wheel or a pawl and ratchet lever 89 and suitable controlling dogs or pawls.

The elevator 19 has a frame comprising spaced side channels 91 suitably reinforced by cross bracing members, and carrying a head roller 92 at its upper end and a foot roller 93 at its lower end around which travels the conveying belt 94. A spring actuated idler roller 95 passes upwardly against the return run of the belt direct-

ly back of the head roller 92. The lower end of the elevator receives the dirt directly from the plow 18, and sideboards 96 confine the dirt on the upwardly traveling run of the belt as it is carried up to the delivery point. The elevator 5 inclines downwardly through the large opening or bay 98 defined between the front and intermediate frame structures 27, 28. The lower portion of the elevator frame has vertically swinging connection with the main frame, established by swinging links 101 (Fig. 2) arranged at each side of the elevator frame and having their swinging ends pivotally connected with brackets 102 secured to each side of the elevator frame and having their opposite ends pivotally 10 mounted in U-shaped brackets 103 (Fig. 2), which latter brackets are secured to the vertical frame bars 27a and 28a of the front and intermediate transverse frame structures 27 and 28. A wide ground engaging runner 106 having 20 an upturned deflecting toe at its front end is operatively connected with the lower end of the elevator for sliding along the ground in immediate proximity to the plow 18, this runner or shoe extending rearwardly under the foot roller 25 93 to protect the latter and the belt 94 from the ground, and in some instances to sustain part of the weight of this end of the elevator on the ground. Flexible link connections are established between the front and rear ends of this runner 30 106 and front and rear portions of the main frame to sustain any fore and aft forces acting against this lower end of the elevator.

Vertical adjustments of the elevator are effected through a lower pair of chains 111 connecting with the lower portion of the elevator, and through an upper pair of chains 112 connecting with the upper and intermediate portions of the elevator. Referring to Fig. 3, the lower chains 111 are disposed one at each side 40 of the elevator frame and each chain is reeved around a sheave 114 connected to the elevator and around a sheave 115 suspended from the frame. The take-up end of each chain is wound around a longitudinally extending shaft 116 rotatably supported on the transverse frame structures 27 and 28. Any suitable actuating mechanism is operatively connected with said shaft for causing rotation thereof in one direction or the other to raise or lower this end of the elevator frame. An operator's platform 121 is provided at the rear end of the machine, extending from the intermediate frame structure 28 to the rear frame structure 29, and this actuating mechanism for turning the shaft 116 is disposed for 55 convenient operation by an operator standing on said platform.

Referring now to the upper pair of chains 112, it will be seen from Fig. 4 that the take-up ends of these two chains both wind upon a rotatable 60 adjusting shaft 122 which is suitably journaled in bearings 123 and 124 supported on the horizontal top rails 27c and 28c of the front and intermediate frame structures 27, 28. From this wind-up shaft, the two chains extend upwardly 65 and outwardly over idler sheaves 125 rotatably mounted on the supporting shaft 126 which has supporting brackets 127 secured to the upper ends of the vertical frame bars 27a, 28a. The chains extend outwardly from these idler sheaves 70 and are looped around sheaves 128 at each side of the elevator frame, each of said sheaves 128 being connected with the elevator frame through a pivoted link 129. From said outer sheaves 128 the chains extend back over a second pair of 75

idler sheaves 131, also mounted on the supporting shaft 126, and thence extend downwardly for attachment through pivoted link bars 132 with intermediate points of the elevator frame, the pivotal connections between said link bars and the frame being indicated at 133. From the foregoing it will be seen that rotation of the wind-up shaft 122 will either take in or pay out the chains 112 and thereby raise or lower the outer portion of the elevator; it being noted that each chain 112 applies its force to the elevator at the points 128 and 133, thereby establishing in effect a resultant force which acts on the elevator at a point intermediate these two points. The adjustability of the elevator effected through the chains 112 enables the outer end of the elevator to be raised or lowered for clearing load receiving trucks and wagons of different heights, and also enables the elevator to be retained in its desired angular relation to the horizontal as the rear axle of the grader inclines under different operating conditions. We shall hereinafter describe the mechanism for rotating the wind-up shaft 122.

The elevator comprises two relatively foldable sections which enable the outer section to be folded upwardly for passing across narrow bridges and through other restricted spaces. The hinge line between the inner and outer sections is substantially coincident with the pivot centers 133 to which the inner ends of the chains 112 are attached. Normally the two sections are held in rigidly coextensive alignment by splice bars 135 which are bolted to the two sections across the hinge axis. To permit the outer section to be folded upwardly, it is only necessary to unbolt these splice bars and to remove short sections of the side-boards 96 directly above the hinge axis, whereupon the outer section of the elevator can be swung up to an approximately vertical position. At this time the inner section may be allowed to rest on the longitudinal brace bar 41 (Fig. 2).

A power drive is transmitted to the belt conveyor 94 through a drive chain 138 which extends outwardly over a sprocket wheel 139 (Fig. 1) mounted on one end of the shaft carrying the head roller 92. The inner loop of this chain passes around a sprocket wheel 141 (Figs. 3 and 4) secured to a power countershaft 142 suitably journaled in bearings 143. These bearings 143 are mounted on an auxiliary frame structure 144 carried by the transverse frame structure 27. The upper run of said drive chain passes over an idler sprocket 145 journaled in the outer end of a swinging link 145' and normally urged upwardly by a tension spring 145'' whereby sufficient slack can be provided in the chain to accommodate the various vertical adjustments of the elevator without having the upper run of the chain sag down and become fouled with any of the other parts. The countershaft 142 is driven by a large sprocket wheel 146 secured thereto, over which passes a drive chain 147. The loop of this chain encircles the torque tube 21 and passes over a sprocket wheel 148 directly below said torque tube and also passes over a sprocket wheel 149 which is driven by a gasoline engine power plant 151. The sprocket wheel 148 has an anti-friction bearing mounting on a stub shaft 148' which is supported in a bearing 150 (Figs. 1 and 3) which is secured to the attachment bracket 24. Referring to Fig. 2, the bed of the engine is supported at its rear end on a

bracket 25m projecting as an integral part of the attaching fin 25 and on a bracket 152 secured to a horizontal bar 28g constituting part of the intermediate frame 28; and the front end of the engine bed is supported on a similar arrangement of brackets on the attaching fin 24 and on a bar of the front frame 27 corresponding to the bar 28g. It will be noted that the weight of the engine serves in a counterbalancing capacity to counterbalance a part of the overhanging weight of the outer end of the elevator and the load carried thereby, and also serves to aid in holding the plow down in the ground. The location of the engine closer to the plow side of the frame is a helpful factor in the above, and its location between the vertical planes of the transverse frame structures 27 and 28 avoids twisting stresses in these frame structures. The engine is preferably housed against dirt and has a cleaner for its air supply, etc. Referring to Figs. 3 and 4, a housing 155 at the front end of the motor encloses a conventional clutch and a speed reducing gear mechanism which are interposed in the driving train between the crank shaft of the motor and the sprocket wheel 149. The driving of the belt conveyor with its relatively heavy loads of soil requires a considerable amount of power and it is preferable to employ a separate engine on the grader for driving the conveyor, substantially as described above, so as to relieve the tractor of this duty and enable its full power to be devoted to traction effort, particularly with a grader of large excavating capacity. However, the present construction can be quickly converted into a type of machine where this power is derived through a power take-off attachment extending back from the tractor. It will be noted that the front supporting casting 22 is provided with a hole 157 extending longitudinally therethrough directly below the torque tube 21, and in adapting the machine to a power take-off drive an extension shaft 158 (Figs. 1 and 6) is extended through this hole and has its rear end arranged to transmit power to the large sprocket wheel 146 through a driving connection similar to the chain drive 147. In the preferred manner of effecting the conversion, the stub shaft 148' with the sprocket wheel 148 are removed by removing said stub shaft from the bearing 150, whereupon the rear end of the extension shaft 158 is seated in the bearing 150 for rotation therein. This extension shaft carries a small sprocket wheel 159 similar to the sprocket wheel 148 for transmitting a chain drive to the large sprocket wheel 146. This is the preferred manner of effecting the conversion but as an alternative method the stub shaft 148' and sprocket wheel 148 may be left in place, and the rear end of the extension shaft 158 may be provided with any suitable driving socket or coupling for establishing driving connection with said sprocket wheel 148. When power is thus transmitted from the extension shaft 158, either through the small sprocket wheel 159 mounted directly thereon, or through a coupled connection with the sprocket wheel 148 on the stub shaft 148', it is preferable to use a shorter chain 147 which will pass directly over the top of said small sprocket wheel 159 or 148, under the torque tube 21, and directly to the top of the large sprocket wheel 146. This is the driving arrangement adopted when the grader has no engine 151 and receives all power for the elevator through the power take-off attachment and would also be the preferred arrangement in

cases where the grader has an engine but where the power take-off attachment has been installed for an emergency situation, such as because of failure of the engine. However, in the latter case, where the grader has an engine, and the power take-off attachment is installed for an emergency, the chain travel might be left as indicated in Fig. 3, with the run of the chain traveling from the sprocket wheel 148 up to sprocket wheel 149 normally driven by the engine 151, in which case the engine clutch within the housing 155 would be disengaged.

The forward portion of the extension shaft 158 is journaled in a bearing 161 (Fig. 6) which is mounted on a bracket 162 adapted to be secured to the front side of the supporting casting 22. This end of the shaft has a coupling connection 158', either of polygonal formation or of tapered formation with a key, for socketed engagement in one section of a universal joint 164. An extensible shaft 165, comprising two telescoping shaft sections of polygonal cross section, extends forwardly from this universal joint and connects with a front universal joint 166 which is in turn adapted to be connected with any conventional power take-off shaft on the tractor. It will be seen from the foregoing that our improved construction enables one fixed design of grader to be readily converted to an arrangement for driving the elevator and adjusting mechanism from an engine on the grader, or to an arrangement for driving the elevator and adjusting mechanism from a power take-off attachment extending from the tractor; and in the former case it also enables the power take-off attachment to be readily applied for emergency situations in the event of engine failure. If desired, the power take-off extension shaft 158 may remain permanently assembled in graders provided with an engine, for immediate emergency use.

The mechanism for vertically adjusting the plow 18 and for vertically adjusting the elevator 19 is illustrated in two embodiments—one manually actuated as shown in Figs. 1 and 2, and the other power actuated as shown in Figs. 3, 4 and 5. Referring to the manually actuated embodiment, the upper portion of the stiff leg member 82 for adjusting the plow 18 is formed with rack teeth 82' along its inner edge which mesh with a pinion 171 (Fig. 5). This pinion is secured to a longitudinally extending shaft 172 which is journaled in bearings 173 secured to the upper corners of the transverse frame structures 27 and 28. A yoke 174 is mounted on said shaft and carries a roller 174' at its outer end which embraces and bears against the back edge of the rack bar 82 for holding the latter in mesh with the pinion 171. Supported in convenient position for actuation from the operator's platform 121 is a hand wheel 175 which is operatively connected to rotate the shaft 172 through speed reducing gearing comprising sprockets and chains or cooperating gears whereby the necessary mechanical advantage is afforded for enabling the rotation of the hand wheel 175 to exert a heavy thrusting force on the rack bar 82 to thrust the plow into the ground or to raise it to an elevated position. Any suitable locking mechanism may be associated with or embodied in the speed reduction mechanism 176 for holding the rack bar 82 at any desired point of adjustment. The mechanism for manually adjusting the elevator 19 also comprises a hand wheel 181 suitably supported for actuation from the operator's plat-

form. As shown in Fig. 2, this hand wheel rotates a pinion 182 which meshes with a large spur gear 183 secured to the wind-up shaft 122. Hence, rotation of the hand wheel 181 in one direction or the other is operative to raise or lower the elevator, and the wind-up shaft 122 may be locked with the elevator adjusted to any desired position by the provision of a suitable locking dog or pawl cooperating with one of the gears 182 or 183.

Referring now to the power actuated mechanism for adjusting the plow and the elevator, it will be seen from Fig. 5 that one end of the power countershaft 142 is provided with a sprocket wheel 187 which drives a chain 188 extending upwardly and over an upper sprocket wheel 189. Said upper sprocket is secured to a reversing gear jack shaft 191 which is rotatably supported in suitable bearings 192 mounted on a platform or supporting plate 193. This supporting plate is secured to the transverse frame structure 27 and to a transverse frame bar 194 extending between the longitudinal bars 37, 37a. Mounted for independent rotation on said jack shaft are two bevel gears 196 and 197 which mesh with a third bevel gear 198 mounted on a stub shaft disposed at right angles to said jack shaft. This stub shaft is journaled in a bearing 199 and carries a sprocket wheel 201 at its outer end. A clutch collar 202 is splined to the jack shaft 191 between the gears 196, 197 for shifting movement to effect clutching between said jack shaft and either one of said gears selectively, as shown in Fig. 4. A shifting yoke 205 engages in an annular groove in the clutch collar for shifting the latter, and this yoke is mounted on a vertical shaft 206 suitably supported for oscillation. An arm 207 extending forwardly from said vertical shaft is operatively connected through a link 208 with an arm 209 secured to a longitudinally extending shaft 211, the latter shaft having suitable bearing support at brackets 212 secured to the front and rear frame structures 27 and 28. A control lever 214 extends upwardly from the rear end of said shaft 211, in position for convenient actuation from the operator's platform 121, and it will be evident that motion of said control lever in one direction or the other is operative to place the reversing gearing 196, 197, 198 in condition for transmitting rotation in either direction to the sprocket wheel 201.

A chain 216 extends from this sprocket wheel up to a sprocket wheel 217 mounted on a transversely extending shaft 218. The latter shaft has bearing support in a journal hub on the outer end of a bearing arm 219, and the inner end of this shaft is adapted to transmit power to worm gear mechanism enclosed in a housing 221. Said housing is suitably supported on the transverse frame structure 27 (the bearing arm 219 projecting outwardly from said housing) and the worm wheel in said housing is operatively coupled to the wind-up shaft 122 on which the chains 112 are wound for raising the elevator. The shaft on which the worm is mounted projects laterally from said housing in alignment with the shaft 218 and carries a jaw clutch 223 on its projecting end. A cooperating jaw clutch 224 is shiftably mounted on the shaft 218 and is shifted into and out of clutching engagement with the clutch element 223 through the actuation of a shifting yoke 225 which has operative connection with a shifting collar associated with the clutch element 224. The shifting yoke 225 has

pivotal mounting in a bracket 226, and is actuated by control connections which we shall presently describe.

The opposite end of the transverse shaft 218 is operatively connected through a universal joint 228, shaft 229 and universal joint 231 with another transverse shaft 232 which is arranged to drive a second worm gear mechanism 233, similar to the above described worm gear mechanism 221. The housing of said latter mechanism is likewise suitably supported on the transverse frame structure 27, with a bearing arm 234 extending inwardly therefrom and providing a bearing boss for the shaft 232. The worm wheel in the housing 233 is operatively connected with the shaft 172 which drives the pinion 171 serving to raise and lower the plow. Also, like the aforementioned worm gear mechanism, the shaft of the worm projects outwardly from the housing and carries a jaw clutch element 235 which is adapted to be engaged by a cooperating jaw clutch element 236 shiftably mounted on the shaft 232. Shifting of the latter clutch element is accomplished through a shifting yoke 237, having coaction with a shifting collar associated with the clutch element 236, and this yoke 237 is mounted on the end of a longitudinally extending shaft 238 which has support in bearing brackets 239 on the transverse frame structures 27 and 28. An arm 241 depending from the rear end of said shaft is operatively connected through a link 242 with a control lever 243 which is pivotally supported on the frame structure 28 in convenient position for actuation by the operator standing on the platform 121. The two shifting yokes 225 and 237 are made to swing correspondingly with the rocking of the shaft 238 through a tie link 244 which is pivotally connected with both yokes. The control lever 243 plays in a slotted plate 246 and has a detent lug 247 which is adapted to engage in any one of three notches 248, 249 or 250. When the detent is engaging in the central notch 248 both shiftable jaw clutches 224 and 236 are held in their disengaged positions whereby no power is transmitted to either of the worm gear mechanisms 221 or 233. Swinging of the lever 243 to place the detent 247 in the notch 249 is operative to shift the jaw clutch 224 into driving engagement with its companion clutch element 223, at the same time more widely separating the other two clutch elements 236 and 235. Power can now be transmitted to the worm gear mechanism 221 for rotating the wind-up shaft 122. Swinging the control lever 243 in the opposite direction to place the detent in the notch 250 is operative to swing the yokes 225 and 237 in the opposite direction for establishing clutching engagement between the clutch elements 236, 235 and more widely separating the clutch elements 224, 223. At this time power can be transmitted through the worm gear mechanism 233 to the pinion 171 for adjusting the plow 18. It will thus be seen that by appropriately placing the lever 243, operative connections may be established for transmitting power to the wind-up shaft 122 or to the pinion 171, and by appropriately actuating the control lever 214 a drive can be transmitted to these devices in either direction for raising or lowering the elevator or for raising or lowering the plow. It will be understood that the plate 246 with its notches 248—250 is only typical of different types of locking devices which may be employed.

It will be observed that the sprocket wheel 146 and its shaft 142 constitute in effect a power driven member which can selectively receive power either from the power plant 151 or from the power take-off attachment 164, 165, 166; i. e., the sprocket wheel 149 constitutes means for driving the power driven member 146 from the power plant 151; and the sprocket wheel 159 (or 148) and its shaft 158 constitute means for driving the power driven member 146 from the power take-off attachment 164—166. It will also be noted that two trains of motion transmitting parts branch from a single reversing mechanism 198, 197, 198, one to the plow and one to the elevator:—the train of motion transmitting parts extending to the elevator comprises the chain 216, shaft 218, clutch 223, 224, worm gear mechanism 221, shaft 122 and chains 112; while the train of motion transmitting parts extending to the plow comprises the chain 216, shaft 229, clutch 235, 236, worm gear mechanism 233, shaft 172, pinion 171 and rack bar 82. By interposing the reversing mechanism 198, 197, 198 between the power driven member 146 and the point where the two trains of motion transmitting connections branch apart toward the elevator and toward the plow, the same reversing mechanism is operable to selectively transmit reversed directions of adjusting motion either to the elevator or to the plow.

In a machine provided with power actuated adjusting mechanism for adjusting the plow or adjusting the elevator, such as is illustrated in Figure 5, it might be desirable at times to be able to adjust either the plow or the elevator manually, as would be true if the adjustment of either of these were desired when no source of power was operative or functioning.

Figure 7 illustrates a modified arrangement by which the adjustments of the plow or of the elevator can be performed selectively either by power or by hand. The stub shaft which carries the bevel gear 198 at one end and the sprocket wheel 201 at the other end, which stub shaft is here designated 260, is provided in this modified arrangement with another bevel gear 261 mounted on the outer end thereof between the sprocket wheel 201 and the bearing boss 199. This additional bevel gear 261 meshes with a bevel pinion 262 which is rotatably mounted on the end of a shaft 263. The latter shaft is journaled in two spaced bearing brackets 264 and 265 which are secured to the platform or supporting plate 193. Between these bearing brackets the shaft 263 is provided with a spline along which slides a clutch collar 267 having jaw teeth in its front face. This clutch collar is adapted to have clutching engagement with cooperating jaw teeth in the adjacent face of a second clutch collar 268 which is freely rotatable on the shaft 263 and which has driving connection with the bevel pinion 262 through the medium of a sleeve extending from the clutch collar 268 forwardly through the bearing 264 to the bevel pinion 262. The rear end of the shaft 263 is connected through a universal joint 271 with a shaft 272 which extends rearwardly and upwardly, passing alongside the engine 151, and having its rear portion supported in a bearing bracket 273 which is suitably secured to one of the frame bars of the transverse frame structure 28. A hand wheel 274 secured to the rear end of this shaft 272 is disposed in convenient location for actuation by the operator standing on the rear platform 121. A pull rod 276 is actuatable from a point in proximity to the

wheel 274, and this pull rod extends down to the clutch parts 267, 268, where it is linked to a shifting lever or yoke 278 suitably pivoted to the platform 193. This shifting lever or yoke has suitable engagement with an annular groove in the shiftable clutch collar 267, whereby upon rearward actuation of the rod 276 the clutch collar 267 is pulled out of engagement with the clutch collar 268, and on forward motion of the rod 276 the two clutch parts are cooperatively coupled. When the adjusting operations are being performed by power the clutch parts 267 and 268 are preferably uncoupled so that no motion is transmitted to the hand wheel 274. In the event that it is desired to adjust either the elevator or the plow independently of the transmission of any power to the gear set 196—198, it is only necessary to shift the clutch collar 202 of this reversing gear set into neutral position, and to couple the two clutch collars 267, 268, whereupon rotation of the hand wheel 274 in the appropriate direction is operative to either raise or lower the plow or the elevator. The rotative motion transmitted from the hand wheel can be directed selectively to adjust the plow or to adjust the elevator through the appropriate shifting of the control lever 243, for directing such motion either to the shaft 122 or to the shaft 172. The worm gear mechanisms 221 and 233 are preferably, although not essentially, of the non-reversible type so that any adjustment transmitted therethrough to the elevator and to the plow is self-locking at the respective worm mechanism. By having the manually operated adjusting motion transmitted from the wheel 274 to the worm driving shafts 218 and 232, this non-reversible characteristic does not interfere with these manual adjustments, and in fact makes each of these manual adjustments also self-locking.

All forces created by the overhanging weight of the elevator and by the vertically acting stresses of the plow are borne by the three points of support of the frame, represented by the two rear wheels 16 and by the ball and socket joint 23a. This three-point support of the frame enables the major portions of the aforesaid stresses to be borne as torsion loads on the torque tube 21, all as fully described in our earlier application of which this is a division.

While we have illustrated and described what we regard to be the preferred embodiment of our invention, nevertheless it will be understood that such a merely exemplary, and that numerous modifications and rearrangements of parts may be made without departing from the essence of the invention.

We claim:—

1. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an elevator supported on said frame for loading the soil broken up by said plow, and power actuated mechanism for adjusting said plow and adjusting said elevator, said power actuated mechanism including reversing mechanism for transmitting adjusting motion to said plow and to said elevator in opposite directions, and including self-locking mechanism for automatically holding the plow and elevator in the different positions to which they have been adjusted.

2. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an elevator supported on said frame for loading the soil broken up by said plow, and power actuated mechanism

for adjusting said plow and adjusting said elevator comprising a power driven member, reversing mechanism receiving power from said power driven member, a train of motion transmitting parts extending from said reversing mechanism to said plow, a train of motion transmitting parts extending from said reversing mechanism to said elevator, and means for selectively controlling the transmission of motion through each of said trains of motion transmitting parts.

3. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an adjusting member operatively connected with said grading plow and comprising a rack, a pinion meshing with said rack and adapted to transmit motion thereto for raising or lowering said grading plow, an elevator supported on said frame for loading the soil broken up by said plow, means for raising and lowering said elevator comprising a winding member and a flexible member operatively connected with said elevator and adapted to be wound upon and unwound from said winding member, power actuated mechanism for adjusting said plow and adjusting said elevator comprising a power driven member, reversing mechanism receiving power from said power driven member, a train of motion transmitting parts extending from said reversing mechanism to said pinion, a train of motion transmitting parts extending from said reversing mechanism to said winding member, and means for selectively controlling the transmission of motion through each of said trains of motion transmitting parts.

4. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an elevator supported on said frame for loading the soil broken up by said plow, and power actuated mechanism for adjusting said plow and adjusting said elevator comprising a power driven member, reversing mechanism receiving power from said power driven member, a train of motion transmitting parts extending from said reversing mechanism to said plow, a train of motion transmitting parts extending from said reversing mechanism to said elevator, clutches interposed in each of said trains of motion transmitting parts, control means for controlling said reversing mechanism for transmitting motion in either direction to either of said trains of motion transmitting parts, and control means for selectively engaging or disengaging said clutches to control the transmission of such motion through either of said trains of motion transmitting parts.

5. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an elevator supported on said frame for loading the soil broken up by said plow, a driving member, a train of motion transmitting parts extending from said driving member to said plow, a train of motion transmitting parts extending from said driving member to said elevator, a power operated member supported on said frame, and optionally operated mechanisms for transmitting motion from said power operated member or from said manually operated member to said driving member.

6. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, means for adjusting said grading plow comprising a rack operatively connected with the plow and a pinion for

transmitting motion to said rack, an elevator supported on said frame for loading the soil broken up by said plow, means for adjusting said elevator comprising a winding member and a flexible member operatively connected with the elevator and adapted to be wound upon and unwound from said winding member, a power driven member, reversing mechanism receiving power from said power driven member, a train of motion transmitting parts extending from said reversing mechanism to said pinion, a train of motion transmitting parts extending from said reversing mechanism to said winding member, means for selectively controlling the transmission of motion through each of said trains of motion transmitting parts, and manually operated adjusting means operative to transmit adjusting motion to said pinion and to said winding member through said trains of motion transmitting parts.

7. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an elevator supported on said frame for loading the soil broken up by said plow, power actuated adjusting mechanism for adjusting said plow and adjusting said elevator comprising a power driven member, a train of motion transmitting parts extending from said power driven member to said plow and including worm gear mechanism, a train of motion transmitting parts extending from said power driven member to said elevator and including a winding member, and means for selectively controlling the transmission of motion through each of said trains of motion transmitting parts.

8. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an elevator supported on said frame for loading the soil broken up by said plow, a power plant mounted on said frame, a power take-off shaft mounted on said frame adapted to have operative connection with a power take-off device on a separate propelling vehicle, reversing mechanism mounted on said frame, and means for transmitting power from said power plant or from said power take-off shaft to said reversing mechanism, mechanism for adjusting said plow and adjusting said elevator comprising a train of motion transmitting parts branching from said reversing mechanism to said plow and comprising a train of motion transmitting parts branching from said reversing mechanism to said elevator, and means for selectively controlling the transmission of motion through each of said trains of motion transmitting parts.

9. In an elevating grader, the combination of a wheel supported frame, a grading plow operatively connected with said frame, an elevator supported on said frame for loading the soil broken up by said plow, a power plant mounted on said frame, a power take-off shaft mounted on said frame adapted to receive power from a power take-off device on a propelling vehicle, reversing mechanism mounted on said frame, means for transmitting power from said power plant or from said power take-off shaft to said reversing mechanism, a train of motion transmitting parts extending from said reversing mechanism to said plow, a train of motion transmitting parts extending from said reversing mechanism to said elevator, and means for selectively controlling the transmission of motion through each of said trains of motion transmitting parts, and manually operated adjusting means for transmitting adjusting motion to said

plow and to said elevator through said trains of motion transmitting parts.

10. In an elevating grader adapted to be propelled by a separate propelling vehicle, the combination of a wheel supported frame, a grading plow operatively connected with said frame, adjusting mechanism for adjusting the position of said plow relatively to said frame, a power plant mounted on said frame, a power take-off member mounted on said frame adapted to be operatively connected with a power take-off device on said propelling vehicle, a manually operated adjusting member mounted on said frame, and means for transmitting motion from said power plant or from said power take-off member or from said manually actuated adjusting member, to said adjusting mechanism for adjusting the position of said plow.

11. In an elevating grader adapted to be propelled by a propelling vehicle, the combination of a wheel supported frame, an elevator supported on said frame, adjusting mechanism for adjusting the position of said elevator relatively to said frame, a power plant mounted on said frame, a power take-off member on said frame adapted to have operative connection with a power take-off device on said propelling vehicle, a manually operated adjusting member on said frame, and means for transmitting motion from said power plant, or from said power take-off member or from said manually actuated adjusting member, to said adjusting mechanism for adjusting the position of said elevator.

12. In an elevating grader, the combination of a wheel supported frame, a grading plow connected with said frame, a power operated member mounted on said frame, a manually operated adjusting member mounted on said frame, and mechanism actuatable selectively either from said power operated member or from said manually actuated adjusting member for raising said plow or for exerting positive downward pressure from said frame to said plow independently of travel of said grader, said mechanism including self-locking mechanism for automatically locking said plow in its different positions of adjustment.

13. In an elevating grader, the combination of a wheel supported frame, a grading plow carried by said frame, an elevator carried by said frame for loading the soil broken up by said plow, a power driven member on said frame operative to transmit power independently of the motion of said grader, a train of motion transmitting parts extending from said power driven member to said plow for effecting vertical adjustment of the plow, a train of motion transmitting parts extending from said power driven member to said elevator for effecting vertical adjustment of the elevator, and control means for selectively controlling the transmission of motion from said power driven member through either of said trains of motion transmitting parts and in either direction of motion.

14. In an elevating grader, the combination of a wheel supported frame, a grading plow carried by said frame, an elevator carried by said frame for loading the soil broken up by said plow, a power driven member on said frame operative to transmit power independently of the motion of said grader, a train of motion transmitting parts extending from said power driven member to said plow for effecting vertical adjustment of the plow, a train of motion transmitting parts extending from said power driven member to said elevator for effecting vertical adjustment of the elevator,

and control means for selectively controlling the transmission of motion from said power driven member through either of said trains of motion transmitting parts, including a single reversing mechanism for transmitting either direction of motion through either train of parts.

15. In an elevating grader, the combination of a wheel supported frame, a grading plow carried by said frame, an elevator carried by said frame for loading the soil broken up by said plow, a power driven member on said frame operative to transmit power independently of the motion of said grader, a train of motion transmitting parts extending from said power driven member to said plow for effecting vertical adjustment of the plow, a train of motion transmitting parts extending from said power driven member to said elevator for effecting vertical adjustment of the elevator, self-locking mechanism interposed in one of said trains of motion transmitting parts for automatically maintaining the adjustments which are established through that train of parts, and control means for selectively controlling the transmission of motion from said power driven member through either of said trains of motion transmitting parts.

16. In an elevating grader, the combination of a wheel supported frame, a grading plow carried by said frame, an elevator carried by said frame for loading the soil broken up by said plow, a power driven member on said frame operative to transmit power independently of the motion of said grader, a train of motion transmitting parts

extending from said power driven member to said plow for effecting vertical adjustment of the plow, a train of motion transmitting parts extending from said power driven member to said elevator for effecting vertical adjustment of the elevator, and control means operable to selectively control the transmission of motion from said power driven member through either of said trains of motion transmitting parts but only operable to effect such transmission of motion through one of said trains at a time.

17. In an elevating grader, the combination of a wheel supported frame, a grading plow carried by said frame, an elevator carried by said frame for loading the soil broken up by said plow, said elevator comprising a conveyor, a power driven member on said frame operative to transmit power independently of the motion of the grader, a first train of motion transmitting parts extending from said power driven member to said conveyor for driving the latter, a second train of motion transmitting parts extending from said power driven member to said plow for effecting vertical adjustment of the plow, a third train of motion transmitting parts extending from said power driven member to said elevator for effecting vertical adjustment of the elevator, and reversing mechanism for transmitting either direction of motion through either one of two of said trains of motion transmitting parts.

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