July 8, 1941. J. B. JARMIN 2,248,709

ELEVATING GRADER

Filed May 20, 1940 4 Sheets-Sheet 1

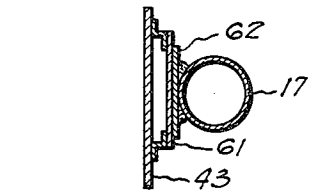


Fig. 6.

Fig. 1.

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ELEVATING GRADER

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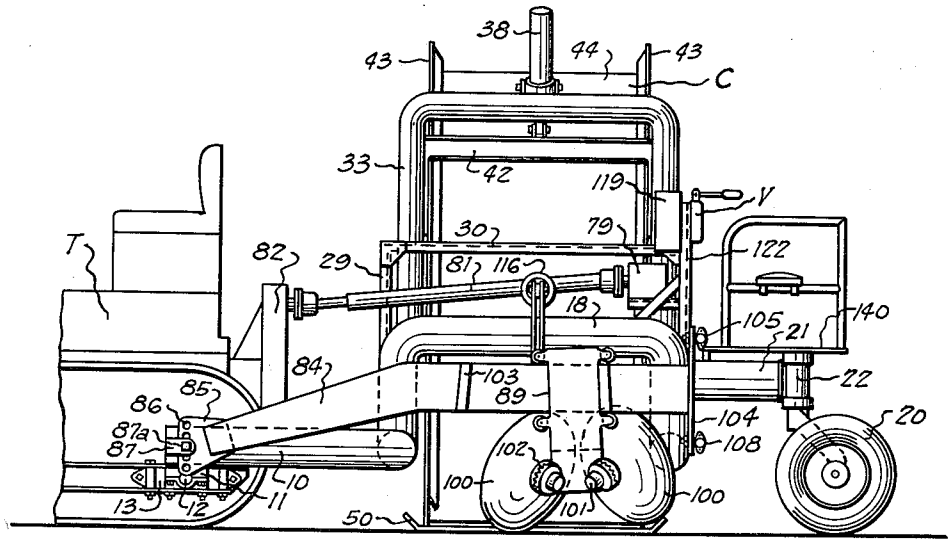


Fig. 2.

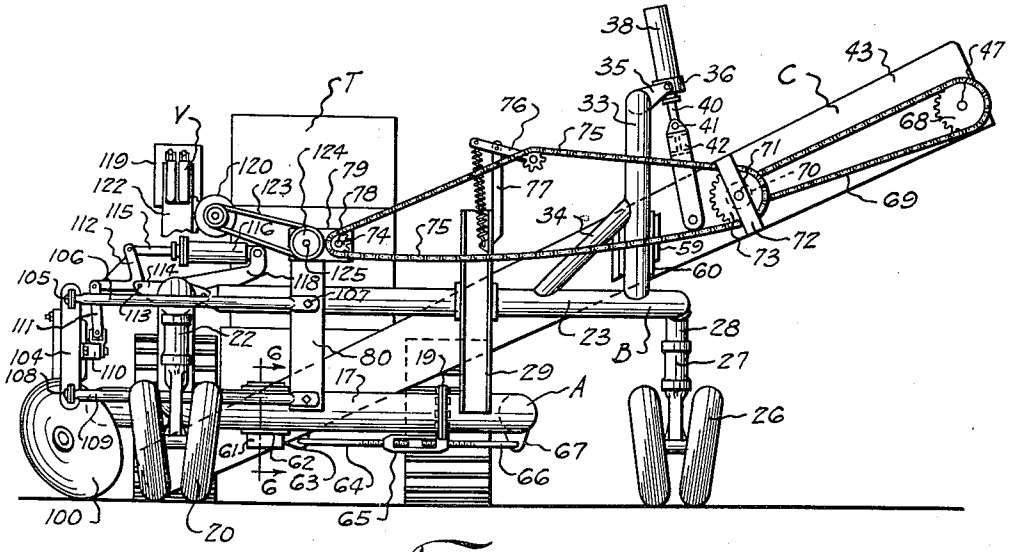


Fig. 3.

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ELEVATING GRADER

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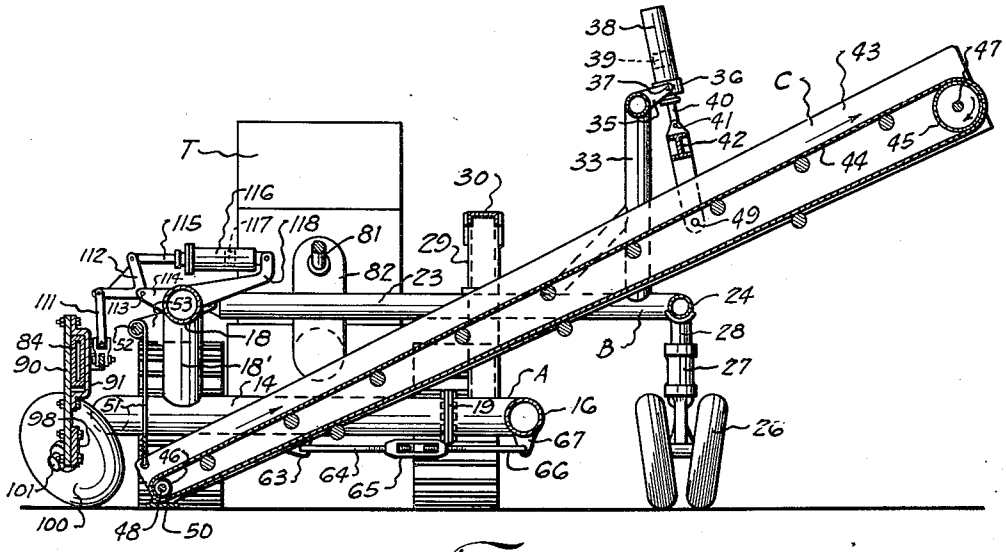


Fig. 4.

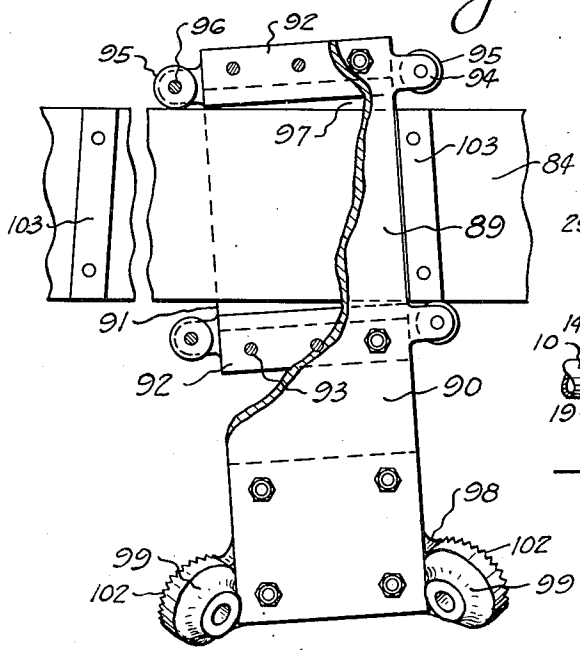


Fig. 8.

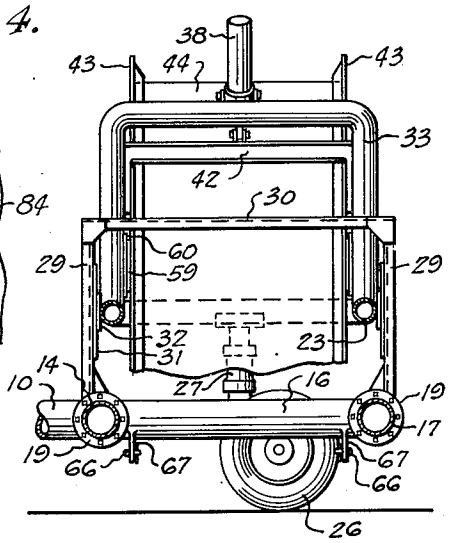


Fig. 5.

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ELEVATING GRADER

Filed May 20, 1940 4 Sheets-Sheet 4

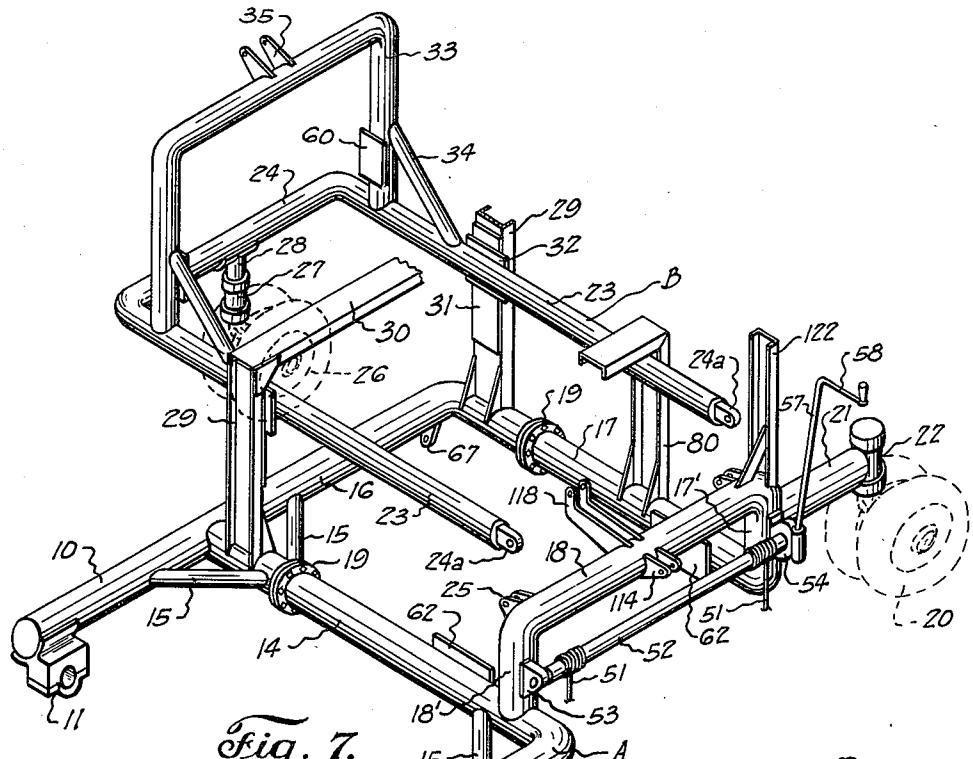


Fig. 7.

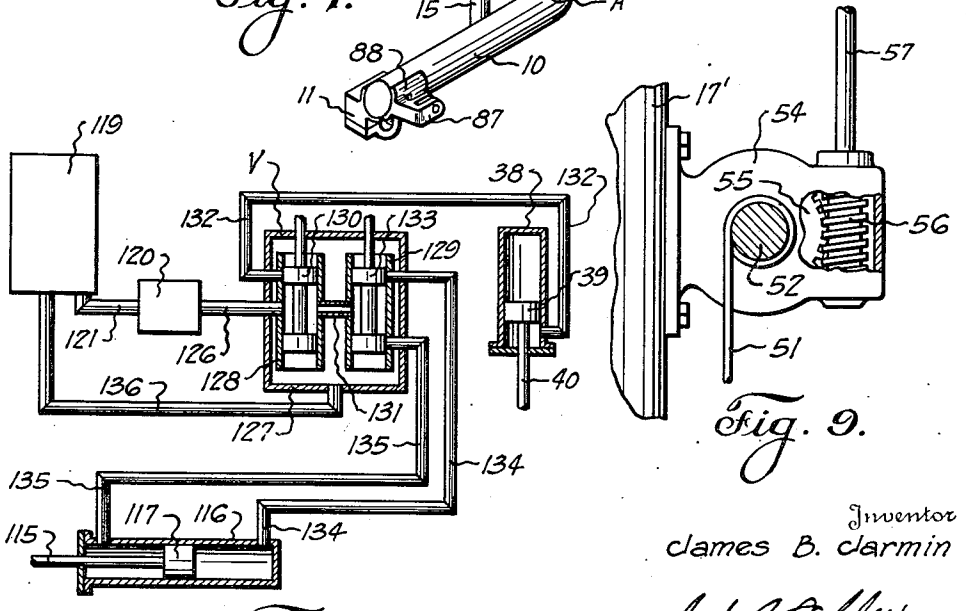


Fig. 10.

Fig. 9.

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UNITED STATES PATENT OFFICE

2,248,709

ELEVATING GRADER

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Application May 20, 1940, Serial No. 336,149

19 Claims. (Cl. 37—110)

This invention relates to new and useful improvements in elevating graders.

One object of the invention is to provide an improved grader for removing dirt from the surface of the earth and for elevating and loading said dirt into trucks, or other hauling vehicles immediately after its removal; the device being relatively simple in construction and economical in manufacture and being so constructed that it will operate efficiently when moved over rough terrain or uneven ground.

An important object of the invention is to provide an improved elevating grader wherein a main frame is attached to the tractor, or other prime mover, so as to be capable of an independent movement in a vertical plane relative to the tractor, together with a sub-frame which carries the elevating means and which is pivoted to the main frame and independently supported on the ground so as to be independently movable in a vertical plane with respect to the main frame and relative to the tractor, whereby roughness or unevenness of the ground over which the grader is moved may be compensated for by the individual vertical movement of the main frame relative to the tractor and of the sub-frame with respect to the main frame, thereby assuring efficient operation of the grader under all ground conditions.

A particular object of the invention is to provide an improved elevating grader having its main frame attached to the tractor so as to be incapable of a lateral movement, or movement in a horizontal plane with respect to the tractor, whereby the turning radius, or the space within which the grader may be turned around while attached to said tractor, is materially reduced and also whereby increased strength and rigidity of the points of attachment of said grader to the tractor are had; the arrangement also permitting the grader to be moved along a predetermined path in a reverse direction by merely reversing the movement of the tractor, or other driving means.

Another object of the invention is to provide an improved grader, of the character described, wherein double plow disks or grader elements are so mounted that when the device is moved in a forward direction, one of the disks acts to remove dirt onto the elevator; movement of the device in an opposite direction causing the other disk to become active in performing the dirt-removing operation, whereby efficient operation is had regardless of the direction of movement of the grader and also whereby turning around the grader and prime mover is not necessary after completing each furrow or trench, which makes the device particularly adapted for use in wooded or other areas having restrictions to the movement of the grader.

A further object of the invention is to provide a grader, of the character described, having a pair of grader disks, which are mounted so as to be automatically moved into and out of cutting position in accordance with the direction of movement of the grader, whereby only one of said disks is engaged with the ground during movement of the grader in one direction, the other disk being raised and inactive during such movement, the positions of the disks being automatically reversed upon a reversal of the direction of movement of the grader.

Still another object of the invention is to provide an improved grader, of the character described, wherein the sub-frame is pivotally mounted with respect to the main frame and is arranged to undergo movement in a vertical plane relative thereto, and also wherein the elevator is suspended within the sub-frame and movable in a vertical plane relative to said sub-frame, together with means for positively guiding the sub-frame with relation to the main frame and for positively guiding the elevator with relation to the sub-frame, whereby twisting strains on the movable parts are eliminated and a sturdy construction is produced.

Another object of the invention is to provide an improved means for adjustably mounting the grader disks to control their cutting depth and also for adjustably mounting the elevator to properly position the same with respect to the ground and also with respect to the grader disks.

Still another object of the invention is to provide an improved hydraulic control for raising and lowering the grader disks and also for raising and lowering the elevator, whereby these parts may be quickly and easily moved to the desired position in accordance with the particular conditions encountered.

A particular object of the invention is to provide an improved elevating grader, wherein the main frame, as well as the sub-frame, are constructed of tubular members, whereby said frames have the desired strength and rigidity, with minimum weight.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in

which an example of the invention is shown, and wherein:

Figure 1 is a plan view of an elevating grader constructed in accordance with the invention and illustrating the same attached to a tractor,

Figure 2 is a side elevation thereof,

Figure 3 is a rear elevation thereof,

Figure 4 is a longitudinal, vertical, sectional view, taken on the line 4—4 of Figure 1,

Figure 5 is a transverse, vertical, sectional view, taken on the line 5—5 of Figure 1,

Figure 6 is an enlarged sectional detail, taken on the line 6—6 of Figure 3,

Figure 7 is an isometric view of the main frame and of the sub-frame, said frame being shown as disconnected from each other to more clearly illustrate the same,

Figure 8 is an enlarged elevation, with portions broken away, of the carrier for the grader disks,

Figure 9 is an enlarged view, partly in section and partly in elevation, of the worm and gear for raising and lowering the lower end of the elevator conveyor, and

Figure 10 is a schematic diagram of the hydraulic system.

In the drawings, the letter A designates a main grader frame having a pair of forwardly directed legs 10 which are spaced from each other and which extend in parallel relation. The legs are arranged to span the rear portion of a tractor T, or other prime mover, and have their forward ends provided with bearing collars 11, which are welded, or otherwise secured thereto. Pivot bolts 12 extend through the collars 11 and also through bearing blocks 13 which are secured to the frame of the tractor, and said bolts act to pivotally connect the frame to the tractor so that said frame may swing or move in a vertical plane with relation to the tractor. However, since the legs 10 of the frame A are disposed, one on each side of the tractor, it is obvious that said frame cannot move laterally, or in a horizontal plane relative to the tractor.

The main frame is preferably constructed of tubular pipe members, as is clearly shown in Figure 7, whereby the desired strength and rigidity, with a minimum amount of weight, is obtained. It is noted, however, that the invention is not to be limited to the use of tubular members as said frame could be made of channel or angle bars, or other suitable elements. As illustrated, the legs 10 are connected to each other by an elongate, tubular member 14, which is preferably integral with one of the legs and which has its free end welded, or otherwise secured, to the other leg. The member 14 and the leg with which it is integral may be formed of a single piece of pipe which is bent upon itself at a right angle and the corner may be braced by a suitable strut 15. The welded connection between the free end of the member 14 and the other leg 10 may also be braced by similar struts 15 which are welded to the connected parts.

The elongate member 14 not only connects the legs 10 but also provides the forward member of the frame A. The leg 10 to which the free end of the member 14 is secured is extended rearwardly to form one of the side members 16 of said frame. At its rear end, the member 16 is bent at substantially a right angle to provide the rear frame member 17, which extends in parallel relation to the forward frame member 14. Opposite the side member 16, the end of the rear frame member 17 is bent upwardly at 17' and then forwardly to form the second side member 18 of the frame A, this side member extending parallel to the first side member 16. The forward end of the member 18 is bent downwardly at 18' and is welded or otherwise secured to the top of the forward frame member 14. With this arrangement, it will be apparent that the frame A is substantially rectangular in shape and is formed by the forward and rear members 14 and 17 respectively, which extend in parallel relation, and by the side members 16 and 18 which are parallel to each other, said side members serving to connect the forward and rear frame members. Due to the upright portions 17' and 18' by which the side member 18 is connected to the forward and rear members 14 and 17, the side member 18 is located in a horizontal plane above the other three members of the frame A. The members 14 and 17 may, if desired, be split intermediate their ends, the separate portions thereof being connected by unions or couplings 19. It has been found that the provision of the unions facilitates dis-assembly and assembly of the frame and also permits transportation of the frame on trucks, railway cars and other vehicles of standard size.

As explained, the frame A has the forwardly directed legs 10 which span the rear portion of the tractor T and which are pivotally secured to the tractor frame to permit the grader frame A to undergo movement in a vertical plane relative to the tractor. The particular attachment of the legs to the tractor frame prevents individual movement of the grader frame A with respect to the tractor T in a lateral or horizontal plane. Thus, the forward end of the frame A is secured to the tractor and for supporting the frame A, a pair of ground wheels 20 are carried by an arm 21 which projects rearwardly from said frame A. The wheels are connected to the arm by a swivel bearing 22 and manifestly, the wheels serve to support the frame above the ground. The attachment of the frame A, as well as the mounting of the ground wheels 20, facilitates turning of the grader frame. When the tractor is turned about, the frame swings around the rear wheels (not shown) of the tractor because said frame A is fastened to the tractor so as to be incapable of individual lateral movement. Therefore, the turning radius of the grader frame is reduced to a minimum.

A sub-frame B is mounted on the main grader frame A and is adapted to have the elevator C suspended therefrom, as will be hereinafter explained. As is clearly shown in Figure 7, the sub-frame B is constructed of a single tubular pipe which is bent into a substantial U-shape, whereby the sub-frame comprises a pair of parallel legs 23 and an end member 24, which connects the outer ends of the legs 23. The inner ends of the legs 23 of the sub-frame are provided with outwardly extending lugs 24a and each lug is adapted to be pivotally mounted between ears 25 which are secured to, and extend inwardly from, the side frame member 18 of the main frame A. With this arrangement, it will be obvious that the sub-frame B has its inner end pivoted to the main frame A and the outer end of said sub-frame extends outwardly beyond the opposite side member 16 of the main frame. The extreme outer end of the sub-frame is supported by ground wheels 26. The wheels are fastened by means of a swivel bearing 27 to a depending shaft 28, which shaft has its upper portion secured to the end member 24 of the sub-frame. Due to the pivotal connection between the inner end of the

sub-frame B and the main frame A, it is obvious that the sub-frame may move in a vertical plane with respect to the main frame. Therefore, as the ground wheels 26 move over uneven ground, the sub-frame may move independently of the main frame.

For guiding the sub-frame B in its vertical movement, upright channel bars 29 extend upwardly from the forward and rear members 14 and 11 of the main frame A. Each upright bar 29 has its lower end welded, or otherwise secured to its respective frame member and the extreme upper ends of the bars 29 are connected by a transversely extending channel bar 30. The bar 30, as is clearly shown in Figure 7, overlies the legs 23 of the sub-frame B. Each upright bar is provided with a bearing plate 31 which is secured to its inner surface and said bearing plate is adapted to be engaged by a complementary bearing plate 32 which is fastened to the adjacent leg 23 of the sub-frame B. Obviously, when the sub-frame A moves vertically on its pivot, the bearing plates 32 slide on the bearing plates 31 which are secured to the upright 29. With this arrangement, the sub-frame B is positively guided during its vertical movement with relation to the main grader frame A.

A U-shaped yoke or hanger 33 is secured to the outer end of the sub-frame B, said hanger having its lower ends welded, or otherwise secured to the outer portions of the legs 23 of said sub-frame. Suitable struts 34 may extend between the hanger 33 and the sub-frame to brace and more securely fasten the parts to each other. The central portion of the hanger 33 is provided with outwardly extending ears 35 which receive a supporting collar 36 (Figure 4) therebetween. The collar 36 is pivoted to the ears 35 by suitable pivot pins 37. A hydraulic cylinder 38 has its lower end secured in the collar 36 and said cylinder has a piston 39 mounted to reciprocate therein. The rod 40 of the piston 39 extends from the lower end of the cylinder 38 and is pivotally connected at 41 to a yoke 42. The yoke 42 spans the elevator C, as is clearly shown in Figure 4. The elevator includes a pair of side bars 43 which are suitably connected together and which have an endless belt or conveyor 44 mounted therebetween. The endless conveyor extends over rollers 45 and 46, said rollers being mounted on shafts 47 and 48 respectively, which shafts extend transversely between the side bars 43 of the elevator.

The elevator extends at an incline and is disposed so as to pass through the hanger 33 and then downwardly through the sub-frame B and through the main frame A. The yoke 42 spans the upper portion of the elevator beyond the hanger 33 and said yoke has the lower ends of its arms pivotally connected at 49 to the side bars 43 of the elevator C. In this manner, the upper end of the elevator is suspended from the hanger 33. When the piston 39 is moved upwardly within the cylinder 38, the yoke 42 is raised, with the result that the upper portion of the elevator C is also raised. Similarly, a downward movement of the piston 39 will result in a lowering of the upper portion of said elevator.

The extreme lower end of the elevator is provided with a transversely extending skid or ground plate 50 which extends transversely between the side bars 43 of the elevator. This skid or ground plate is adapted to engage and ride upon the surface of the ground as the apparatus is moved thereover. For raising and lowering the lower portion of the elevator C, each side bar 43 of said elevator has a chain, cable, or other flexible connection 51 secured thereto. Each flexible connection 51 extends upwardly and passes around a rotatable shaft 52, which shaft has its ends mounted in bearings 53 which extend outwardly from the upset portions 17' and 18' of the main frame A. One end of the shaft 52 extends into a gear housing 54 (Figures 7 and 9) and has a gear 55 fastened thereon. The gear is in contant mesh with a worm 56 which is secured on the lower end of an operating shaft 57. For facilitating the rotation of the shaft and gear, a suitable crank 58 may be made integral with the shaft or may be made removable therefrom. When the gear 55 is rotated through the medium of the worm screw 56, the shaft 52 is rotated to wind or unwind the flexible connection 51 on the shaft 52. Manifestly, this will result in a lowering or raising of the lower portion of the elevator C.

In order to positively guide the elevator C in its vertical movement with relation to the sub-frame and also with relation to the main frame, the side bars 43 of the elevator are provided with bearing plates 59, which are located contiguous to the upright portions of the hanger 33. These plates are adapted to engage complementary bearing plates 60 which are secured to the inner surface of each of the uprights of the hanger. Similarly, the lower portion of each bar 43 of the elevator (Figure 6) is provided with a bearing plate 61 which is adapted to engage and slide upon a bearing plate 62 which is secured to the adjacent member of the frame A. The provision of the bearing plates provide a flat surface between the movable parts and serve to positively guide the elevator in its vertical movement relative to the frames A and B.

In order to provide for a lateral adjustment of the lower portion of the elevator C, the underside of each bar 43 of said elevator is provided with a depending ear 63, which is located near the lower end of said bar. Each ear has one end of a rod 64 pivotally connected thereto and the other end of said rod is threaded into a turnbuckle 65. Another rod 66 is threaded into the opposite end of the turnbuckle and has its outer end pivotally connected to a depending ear 67 which extends downwardly from the side member 16 of the main frame A. When the turnbuckles 65 are adjusted, the rods 64 and 66 are moved inwardly or outwardly relative to the turnbuckles, whereby the lower portion of the elevator C is moved laterally relative to the frame A. This provides for an adjustment of the extreme lower end of the elevator C in a lateral direction.

For rotating the shaft 41 and the roller 45 at the upper end of the elevator C so as to move the conveyor belt 44 longitudinally through the conveyor, said shaft is formed with a gear 68, which is disposed outside of the side bar 43 of the elevator C. This gear has connection through a flexible chain 69 with a small gear 70, said gear being mounted on a stub shaft 71 which is mounted within a bracket 72 secured to the outer surface of the side bar 43. The shaft 71 also has a larger gear 73 mounted thereon and this gear has a driving connection with a pinion 74 through a flexible chain 75. A suitable chain tightener 76 may be mounted on a bracket 77 which extends upwardly from one of the uprights 29 which are secured to the main frame A. When the pinion 74 is rotated, the shaft 71

is also rotated through the medium of the gear 73. This results in a rotation of the gear 70 and also of the gear 68, such drive being through the chain 69. In this manner, the shaft 47 of the roller 45 within the upper portion of the elevator C is rotated, whereby the conveyor belt 44 is moved longitudinally within the elevator C.

The drive pinion 74 is mounted on a shaft 78, which extends into a reduction gear box 79. The gear box is suitably mounted on the upper end of an upright channel member 80, which member extends upwardly from the rear member 17 of the main frame A. The gears (not shown) within the gear box 79 are connected by means of a drive shaft 81 with the usual power take-off 82 of the tractor T. In this manner, the engine of the tractor T is utilized to drive the conveyor belt 44 of the elevator C. A suitable clutch 83 may be associated with the pinion shaft 78, whereby when desired, the operation of the conveyor belt may be halted, even though the drive shaft 81 is rotated.

The shaft 47 and roller 45 are rotated in a clockwise direction in Figure 4, whereby the conveyor belt 44 is moved in the direction indicated by the arrows in this figure. Thus material placed on the lower end of the conveyor belt 44 will be carried to the upper end thereof. For directing dirt onto the lower end of the conveyor belt 44 of the elevator C, a plow is mounted at one side of the main frame A and this plow includes a plow beam 84. The beam has its forward end provided with a plate 85 which has a plurality of openings 86 formed therein. The plate 85 is insertable between ears 87 of a casting 88 which is fastened to one of the legs 10 of the main frame A. A pivot bolt 87*a* extends through the ears 87 and also through one of the openings 86 of the plate 85, whereby the forward end of the beam 84 is pivotally secured to the frame A. The plow beam 84 inclines upwardly with relation to the leg 10 and is then bent so that its rear portion extends in substantially a horizontal plane. The horizontal portion of the plow beam 84 has a carriage 89 slidably mounted thereon and as is clearly shown in Figure 8, the carriage includes an outer plate 90 which is located on the outside of the beam 84. An inner plate 91, which is substantially U-shaped in cross-section (Figure 4) engages around the plow beam and is provided with flanges 92 which engage the rear surface of the outer plate 90. The flanges 92 are bolted to the outer plate by means of bolts 93 so as to form a unitary structure. In order to facilitate the sliding movement of the carriage on the beam 84, the plates 90 and 91 are provided with ears 94 which have rollers 95 mounted therebetween on pins 96. It is pointed out that the distance between the top and bottom of the plate 91 is greater than the width of the beam 84, whereby a clearance 97 is provided between the plate 91 and said beam. In other words, the carriage is loosely slidable on the beam and normally is merely suspended therefrom (Figure 4) with the top of the plate 91 resting on the top of the beam.

A casting 98 is bolted to the lower end of the plate 90 of the carriage and this casting includes a pair of bearing collars 99. Plow or grader disks 100 are secured to the bearing collars 99 by means of bolts or pins 101, which extend through the collars and also through a bore provided in the disks. The engaging faces of each collar 99 and the disk 100 are serrated at 102, whereby each disk is incapable of rotation with respect to its collar 99.

From the foregoing, it will be seen that the disks 100 are mounted on the carriage 89, which is slidable with relation to the plow beam 84. The position of the disks and the carriage is such that one or the other of said disks may be alined with the central portion of the lower end of the elevator C, whereby said disks may be utilized to direct the dirt onto the conveyor belt 44. For limiting the movement of the carrier on the beam so as to properly aline one of the disks with the central portion of the conveyor C and also for automatically lifting one of the disks, a pair of inclined stop bars 103 are provided. When the carriage 89 is in a position intermediate the stop bars 103, said carriage is hanging vertically with respect to the horizontal portion of the beam 84, with the result that both disks 100 are engaging the ground. However, when the device is moved forwardly over the ground, the engagement of the disks with said ground causes the carriage 89 to remain stationary, while the plow beam 84 which is carried by the main frame moves forwardly with the apparatus. Therefore, the carriage 89 is moved to the position shown in Figure 8 and as the rear edge of the plate 90 of said carrier strikes the inclined bar 103, the carriage is inclined from a true vertical position. Such inclination of the carriage results in the forward disk 100 remaining in contact with the ground, while the other disk is lifted out of engagement with the ground, as shown in Figure 2. Similarly, if the direction of movement of the device is reversed, the carriage is moved forwardly with relation to the plow beam and into engagement with the opposite stop bar 103. In such instance, the carriage 89 is inclined in an opposite direction, with the result that the rearmost disk 100 engages the ground, while the forward disk is automatically lifted therefrom. It is noted that the position of the stop bars is such that the particular disk which engages the ground is alined substantially with the center of the conveyor belt 44 so as to direct the dirt which is removed by said disk onto said belt.

As has been explained, the forward end of the plow beam 84 is pivoted to the frame A. For supporting the rear end of said beam, a vertically extending bar 104 is welded, or otherwise secured to the beam. This bar has its upper end connected by means of a ball and socket joint 105 with the outer end of a supporting rod 106. The opposite end of the bar 106 (Figure 3) is pivotally secured at 107 to the upright channel 80 which is carried by frame A. Similarly, the lower end of the bar 104 is fastened by means of a ball and socket joint 108 with a second rod 109. The lower rod 109 is also pivotally secured to the upright 80. For maintaining the beam 84 in its proper position and also for providing for raising and lowering said beam and the disks carried thereby, a bracket 110 extends outwardly from the inner side of the beam, (Figure 4). This bracket is connected by a link 111 with a bell crank lever 112, which lever is pivoted at 113 to an outwardly extending lug 114 which is formed on the frame member 18. The upper end of the bell crank lever 112 is pivotally connected to the outer end of a piston rod 115, which rod extends into a cylinder 116 and is secured to a piston 117 which is reciprocable within said cylinder. The cylinder is supported by means of brackets 118 which extend inwardly from the frame member

18 (Figures 3 and 7). When hydraulic fluid is introduced into either end of the cylinder 116, the piston 117 is moved within the cylinder, with the result that the piston rod 115 swings the bell crank 112. Such swinging of the bell crank will of course result in a raising or lowering of the link 111, whereby the beam 84 is raised or lowered with respect to the ground. It is noted that the beam swings on the pivot bolt 87a which pivotally connects the forward end of the beam to the frame A.

From the above, it will be seen that the raising and lowering of the plow beam 84 and of the disks 100 are controlled by the hydraulic piston 117. Similarly, the raising and lowering of the upper portion of the elevator C is also controlled by a hydraulic piston 39. The fluid to these cylinders 116 and 38 may be controlled in any suitable manner but it is preferable to employ the system which is schematically shown in Figure 10. This system includes a supply tank 119 which is connected to a pump 120 by means of a line 121. The tank 119 and pump 120 are suitably mounted on an upright channel bar 122 which is secured to the main frame A and which extends upwardly therefrom (Fig. 7). The pump may be driven by means of a belt 123 which belt is operated by a drive pulley 124. The drive pulley is secured to a shaft 125 which extends into the gear box 79, whereby the shaft is rotated from the power take-off 82 of the tractor. A suitable clutch 125a (Fig. 1) may be interposed between the gear box and the drive pulley 124, whereby the operation of the pump may be readily controlled. The pump 120 communicates through a line 126 with a valve assembly V which assembly is also mounted on the upright 122. The valve assembly is schematically shown in Figure 10 and includes an outer casing 127 having a pair of open ended cylinders 128 and 129 mounted therein. The cylinder 128 has the line 126 connected intermediate its end and is provided with a valve 130 slidable therein. The valve is of the double plunger type and is arranged so that in all of its positions, a communication between the line 126 and a line 131 which extends from the opposite side of the cylinder 128 is established. When the valve 130 is moved to a raised position, said valve establishes a communication between the line 126 and a line 132 which leads to the lower end of the cylinder 38, whereby fluid from the tank 119 is pumped through the lines 126 and 132 to the lower end of the cylinder 38 to raise the piston 39 within said cylinder. Such raising of the piston results in a raising of the elevator C. By moving the valve to a lowered position so as to move the upper piston element of said valve below the line 132, fluid from the cylinder 38 may drain back into the casing 127, the weight of the conveyor serving to move the piston 39 downwardly within the cylinder 38.

The line 131 which leads from one side of the cylinder 128 communicates with the other cylinder 129. This cylinder has a valve 133, similar in construction to the valve 130 slidable therein. The valve 133 is of the double plunger type and in one position is adapted to close the flow from the line 131 to either of two lines 134 and 135. These lines extend from the cylinder 129 to opposite ends of the operating cylinder 116 which controls the raising and lowering of the plow beam 84. When the valve 133 is raised, a communication is established between the pipe 131 and the line 134, whereby fluid may flow to one end of the cylinder 116 to move the piston 117 in a direction to lower the plow beam. At the same time, lifting of the valve 133 uncovers the inner end of the line 135, whereby fluid may drain from the opposite end of the cylinder 116 and into the casing 127. The casing communicates through a line 136 with the tank 119.

When the valve 133 is in its lowered position, a communication is established between the pipe 131 and the pipe 135, whereby the piston 117 is moved in an opposite direction. During such movement of the piston, the fluid is bled from the opposite end of the cylinder 116 through the line 134 and back into the casing 127, from where it flows into the tank 119.

With this arrangement, it will be obvious that the valves 130 and 133 definitely control the flow of hydraulic fluid to the cylinders 38 and 116 so that the pistons 39 and 117 may be operated as desired. Obviously, either one of the pistons 39 or 117 may be operated individually of the others.

The operation of the elevating grader described herein is obvious. The device includes the main frame A which is secured to the frame of the tractor so as to be capable of a vertical movement, while being incapable of any movement in a lateral plane relative to the tractor. The sub-frame B has its inner end pivoted on the main frame and has its outer end individually supported by the ground wheels 26. Thus, the sub-frame may undergo a movement in a vertical plane relative to the main frame. The inclined elevator C extends through the two frames A and B and has its upper portion suspended from the hanger 33 of the sub-frame, such suspension involving the hydraulic cylinder and piston, whereby the elevator may be raised and lowered with relation to the sub-frame. The lower end of the elevator is provided with the skid or ground plate 50 which engages and rides upon the surface of the ground.

The plow is mounted on the main frame, having the forward end of its beam 84 pivoted to the forward end of one of the legs 10 of said frame. The plow beam is adjustable vertically relative to the ground and to the frame A by means of its forward suspension and may be raised and lowered by the hydraulic cylinder 116 and piston 117 and said beam has the carriage 89 slidably mounted thereon. This carriage has the plow disks 100 mounted thereon and one or the other of said disks is adapted to be alined with the central portion of the conveyor C.

Assuming that the tractor is moving in a forward direction, and also assuming that the carriage 89 is located on the plow beam 84 between the inclined stop bars 103, said carriage is hanging in a vertical position with both plow disks 100 engaging the surface of the ground. As the apparatus moves forwardly, the resistance set up by the engagement of the disks 100 with the ground prevents a movement of the carriage 89, whereby the plow beam moves forwardly relative to the carriage. When the carriage strikes the inclined stop bar 103, as shown in Figure 8, said carriage is inclined from a vertical position, with the result that the forward disk 100 remains in engagement with the ground, while the rearmost disk is raised therefrom. The stop bar is located so that the forward disk is substantially alined with the central portion of the conveyor belt 44.

Continued forward movement of the apparatus causes the forward disk 100 to remove dirt from the surface of the earth and to direct the same onto the conveyor belt 44 which carries the same

upwardly to the top of the elevator. A truck or vehicle (not shown) may be driven along opposite the conveyor and obviously the dirt will be dumped into said truck or vehicle.

It may be desirable to reverse the direction of movement of the apparatus without turning said apparatus around and in such instance, it is only necessary to reverse the tractor. This results in a movement of the apparatus in a reversed direction and when this occurs, the carriage 89 is shifted forwardly with relation to the plow beam until it strikes the inclined stop bar 103 near the forward end of the beam. When this occurs, the carriage 89 is inclined from the vertical so that the forward disk 100 is lifted from the ground, with the rear disk remaining in engagement with the ground and being substantially alined with the center of the conveyor belt 44. A continued rearward movement of the device will result in the rearmost disk 100 removing the dirt from the surface of the earth and directing it onto the conveyor belt 44. Therefore, it will be seen that the particular arrangement of the disks 100 permits the apparatus to operate efficiently in either direction.

The connection of the main frame A to the tractor is important because said frame is limited to a vertical movement relative to the tractor. The main frame cannot move in a lateral or horizontal direction with respect to the tractor, and therefore, the turning radius of the apparatus is materially reduced. In other words, the amount of room or space necessary to completely turn the entire apparatus around is reduced because the frame A may turn around the rear wheels of the tractor, which act as a fulcrum point. Since the sub-frame is pivoted to the main frame and is individually supported by its own ground wheels, said frame may undergo a vertical movement with respect to the main frame. Therefore, the ground wheels 26 of the sub-frame may be at a different level than the ground wheels 20 of the main frame without throwing a twisting strain on any of the apparatus. Since the elevator C is carried or suspended from the sub-frame, it is manifest that any movement of said sub-frame will be imparted to the elevator. In addition to such movement, the elevator C is capable of an individual vertical movement with respect to the sub-frame, such movement being accomplished by means of the hydraulic piston 39 and cylinder 38, as well as by the flexible connection 51 at the lower end of the elevator.

The movable sub-frame B, as well as the elevator C, are positively guided in their vertical movement, such guiding being accomplished by the use of the various bearing plates between the movable parts. The raising and lowering of the upper portion of the elevator C, as well as the vertical movement of the plow beam 84, is accomplished through the hydraulic means, whereby these operations may be quickly and easily accomplished with a minimum amount of effort. The elevator is not only capable of a vertical movement relative to the sub-frame B but also, the lower end of said elevator may be adjusted with respect to the disks 100 by means of the turnbuckles 65, as has been explained. The hydraulic pump 120, as well as the conveyor belt 44 are driven from the power take-off 82 of the tractor and with this arrangement it is not necessary to provide a separate drive means for these elements. The valves V, as well as the crank 58 which controls the raising and lowering of the lower end of the elevator C may be disposed adjacent an operator's platform 140 which is suitably secured to the outwardly extending arm 21 on which the ground wheels 20 of the main frame are mounted. The main frame A, as well as the sub-frame B, are preferably constructed of tubular pipe members, whereby the necessary strength and rigidity is obtained, without unduly increasing the weight of the structure. However, as has been pointed out, the invention is not to be limited to constructing the frames of such tubular elements, as angle or channel bars could be employed.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. An elevating grader including, a main frame arranged to be attached to a prime mover, means for connecting said frame to the prime mover so that said frame is incapable of movement in a lateral plane relative to said prime mover, a sub-frame overlying a portion of the main frame and having one end pivotally secured to the main frame and capable of independent movement in a vertical plane with respect to said main frame, an inclined conveyor suspended from the sub-frame, and a grader element mounted on the main frame for removing dirt from the earth's surface and directing the same onto the conveyor.

2. An elevating grader including, a main frame adapted to be attached to a tractor and connected to said tractor so as to be incapable of an independent movement in a lateral plane with respect to the tractor, a sub-frame having elongate substantially parallel legs, said legs each having one end pivoted to the main frame, said legs having their opposite free ends supported by a ground wheel whereby the sub-frame is movable in a vertical plane relative to said main frame, an inclined conveyor suspended from the sub-frame, and a dirt removing element mounted on the main frame and disposed adjacent the lower end of the conveyor for removing dirt from the surface of the earth and directing the same onto the conveyor.

3. An elevating grader including, a main frame, a sub-frame having substantially parallel legs, each leg having one end pivotally secured to the main frame and having its opposite end secured to the other leg and supported on the ground independently of the main frame so as to be movable relative to the main frame, a conveyor carried by the sub-frame whereby said conveyor is movable independently of the main frame, and means mounted on the main frame for removing dirt from the earth's surface and directing the same onto the conveyor.

4. An elevating grader including, a main frame, an elongate sub-frame having one end mounted inwardly of the side of the main frame and overhanging, and adapted to undergo movement in a vertical plane relative to the main frame, an inclined conveyor having a frame adjustably carried by the sub-frame, and means mounted on the main frame adjacent the lower portion of the conveyor for removing dirt from the surface of the earth and directing it onto the conveyor.

5. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevating conveyor extending through the

frames and having its lower end engaging the ground, means for adjustably suspending the upper end of the conveyor from the sub-frame, and a grader element for directing dirt onto the conveyor as the apparatus is moved over the ground.

6. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevating conveyor extending through the frames and having its lower end engaging the ground, means for adjustably suspending the upper end of the conveyor from the sub-frame, a grader element mounted on the main frame adjacent the lower end of the conveyor for directing dirt onto said conveyor, and means connected with said element for raising and lowering said element with respect to the ground.

7. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevating conveyor extending through the frames and having its lower end engaging the ground, means for adjustably suspending the upper end of the conveyor from the sub-frame, a plow assembly mounted on the main frame and comprising a plow beam having its forward end pivotally connected to the forward portion of the frame, means connected to the beam for raising and lowering said beam, and a grader element mounted on the plow beam for directing dirt onto the conveyor as the grader is moved over the ground.

8. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevating conveyor extending through the frames and having its lower end engaging the ground, means for adjustably suspending the upper end of the conveyor from the sub-frame, a plow assembly mounted on the main frame and comprising a plow beam having its forward end pivotally connected to the forward portion of the frame, means connected to the beam for raising and lowering said beam, a pair of grader elements slidably mounted on the plow beam for directing dirt onto said conveyor, the mounting of the elements being such that one element engages the ground when the grader is moved forwardly while the other element engages the ground upon rearward movement of the grader, whereby the apparatus will operate regardless of the direction in which it is moved.

9. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevating conveyor extending through the frames and having its lower end engaging the ground, means for adjustably suspending the upper end of the conveyor from the sub-frame, a plow assembly mounted on the main frame and comprising a plow beam having its forward end pivotally connected to the forward portion of the frame, means connected to the beam for raising and lowering said beam, a carriage slidably mounted on the plow beam and adapted to tilt from the vertical, a pair of grader elements mounted on the carriage, and means on said beam adapted to co-act with the carriage to tilt said carriage so as to raise one of the grader elements from the ground and also to properly aline the other grader element with the conveyor.

10. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevating conveyor extending through the frames and having its lower end engaging the ground, means for adjustably suspending the upper end of the conveyor from the sub-frame, a plow assembly mounted on the main frame and comprising a plow beam having its forward end pivotally connected to the forward portion of the frame, means connected to the beam for raising and lowering said beam, a carriage slidably mounted on the plow beam and adapted to tilt from the vertical, a pair of grader elements mounted on the carriage, and means on said beam adapted to co-act with the carriage to tilt said carriage so as to raise one of the grader elements from the ground and also to properly aline the other grader element with the conveyor, said last named means being automatically actuated upon the movement of the device over the ground.

11. An elevating grader arranged to be attached to a tractor including, a substantially rectangular main frame, means for pivotally connecting the forward end of the frame to the tractor to permit said frame to swing in a vertical plane relative to the tractor, said connection preventing a lateral movement of the frame with respect to the tractor, a ground wheel for supporting the rear portion of the frame, a sub-frame having one end pivoted to the main frame so as to swing in a vertical plane with relation to the main frame, a ground wheel for supporting the free end of the sub-frame, an inclined elevator extending within the frames and suspended from the sub-frame, means for raising and lowering the elevator relative to the frames, means for positively guiding the vertical movement of the elevator within the frames, and a grader element mounted on the main frame for directing dirt onto the elevator.

12. An elevating grader arranged to be attached to a tractor including, a substantially rectangular main frame, means for pivotally connecting the forward end of the frame to the tractor to permit said frame to swing in a vertical plane relative to the tractor, said connection preventing a lateral movement of the frame with respect to the tractor, a ground wheel for supporting the rear portion of the frame, a sub-frame having one end pivoted to the main frame so as to swing in a vertical plane with relation to the main frame, a ground wheel for supporting the free end of the sub-frame, means for positively guiding the sub-frame in its vertical movement, an inclined elevator extending within the frames and suspended from the sub-frame, means for raising and lowering the elevator relative to the frames, means for positively guiding the vertical movement of the elevator within the frames, a grader element mounted on the main frame for directing dirt onto the elevator, and means for raising and lowering the grader element with relation to the ground.

13. An elevating grader arranged to be attached to a tractor including, a substantially rectangular main frame, means for pivotally connecting the forward end of the frame to the tractor to permit said frame to swing in a vertical plane relative to the tractor, said connection preventing a lateral movement of the frame with respect to the tractor, a ground wheel for supporting the rear portion of the frame, a sub-frame having one end pivoted to the main frame so as to swing in a vertical plane with relation to the main frame, a ground wheel for supporting the free end of the sub-frame, an inclined

elevator extending within the frames and suspended from the sub-frame, means for raising and lowering the elevator relative to the frames, means for positively guiding the vertical movement of the elevator within the frames, a grader element mounted on the main frame for directing dirt onto the elevator, and adjustable means connecting the lower portion of the elevator with the main frame, whereby a lateral adjustment of the conveyor relative to the grader element is possible.

14. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevator extending through the frames and having its lower end resting on the ground, means for suspending the upper portion of the elevator from the sub-frame, hydraulic means associated with the suspending means for raising and lowering the upper portion of said elevator, and a grader element mounted on the main frame adjacent the lower end of the elevator for directing dirt onto said elevator.

15. An elevating grader including, a main frame, a sub-frame mounted to undergo movement in a vertical plane relative to the main frame, an inclined elevator extending through the frames and having its lower end resting on the ground, means for suspending the upper portion of the elevator from the sub-frame, hydraulic means associated with the suspending means for raising and lowering the upper portion of said elevator, a grader element mounted on the main frame adjacent the lower end of the elevator for directing dirt onto said elevator, and hydraulic means for raising and lowering the grader element with respect to the ground.

16. An elevating grader including, a main frame arranged to be attached to a prime mover, means for connecting said frame to the prime mover so that said frame is incapable of movement in a lateral plane relative to said prime mover, a sub-frame overlying the main frame and having one end pivotally secured to the main frame and capable of independent movement in a vertical plane with respect to said main frame, an inclined conveyor suspended from the sub-frame, means for connecting the conveyor to the power take-off of the tractor, whereby said tractor drives the conveyor, and a grader element mounted on the main frame for removing dirt from the earth's surface and directing the same onto the conveyor.

17. An elevating grader arranged to be attached to a tractor including, a substantially rectangular main frame, means for pivotally connecting the forward end of the frame to the tractor to permit said frame to swing in a vertical plane relative to the tractor, said connection preventing a lateral movement of the frame with respect to the tractor, a ground wheel for supporting the rear portion of the frame, a sub-frame mounted on the main frame, an inclined elevator extending within the frames and suspended from the sub-frame, means for raising and lowering the elevator relative to the frames, means for positively guiding the vertical movement of the elevator within the frames, and a grader element mounted on the main frame for directing dirt onto the elevator.

18. An elevating grader including, a main frame adapted to be attached to a prime mover and having a rearwardly extending support which is substantially parallel with the longitudinal axis of the prime mover, a sub-frame having one end pivotally secured to the support, whereby said sub-frame may undergo movement in a vertical plane with respect to the main frame, an inclined conveyor suspended from the sub-frame, and a grader element mounted adjacent the lower end of the conveyor for removing dirt from the earth's surface and directing the same onto the conveyor.

19. An elevating grader including, a main frame adapted to be attached to a prime mover and having a rearwardly extending support which is substantially parallel with the longitudinal axis of the prime mover, a U-shaped sub-frame having its free ends pivotally secured to the support and its closed end supported by a ground wheel, whereby said sub-frame is capable of movement in a vertical plane relative to the main frame, an inclined conveyor mounted on the sub-frame, and means mounted adjacent the lower end of the conveyor for directing dirt onto said conveyor.

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