E. K. ENEBO.

GRADING MACHINE.

APPLICATION FILED JUNE 8, 1915.

1,279,853.

Patented Sept. 24, 1918.

3 SHEETS—SHEET 1.

Fig. 1

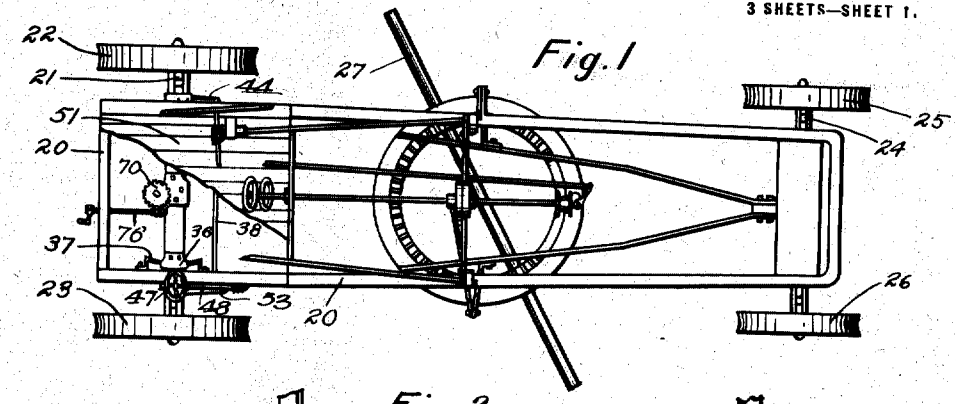


Fig. 2

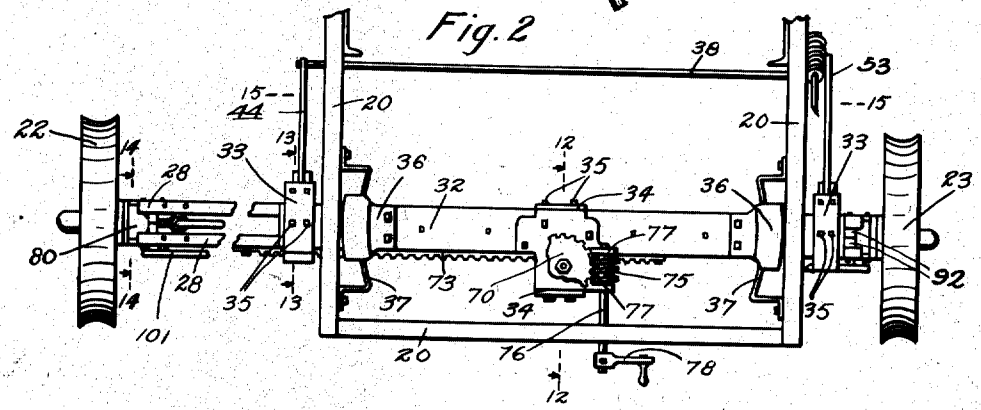


Fig. 3

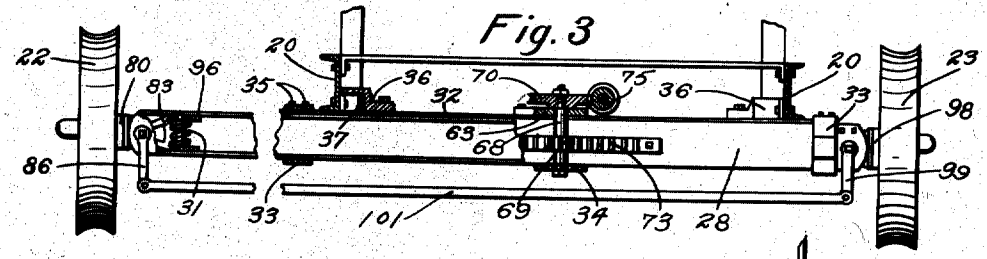
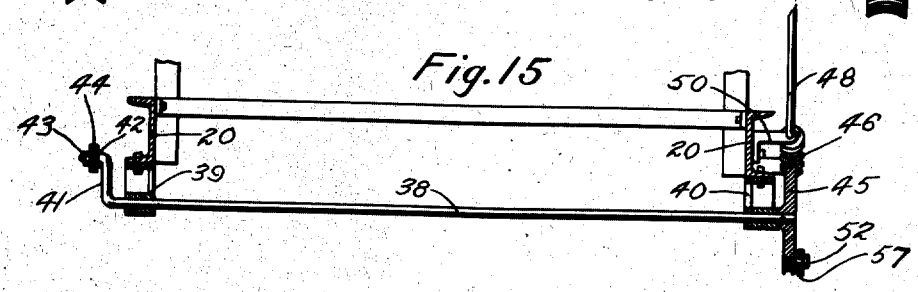


Fig. 15



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H. A. Bowman

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3 SHEETS—SHEET 2.

Fig. 4

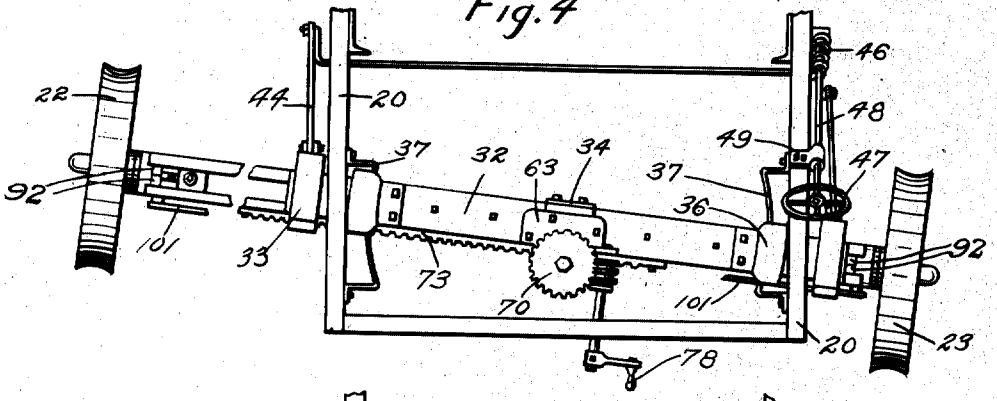


Fig. 5

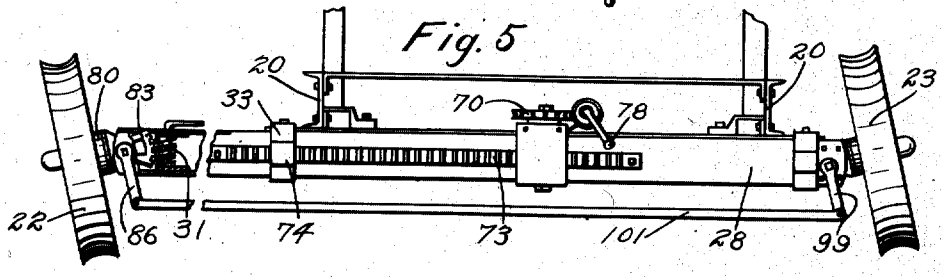


Fig. 7

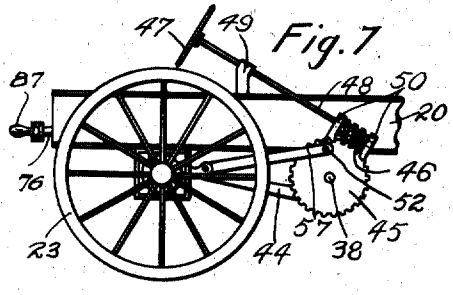


Fig. 6

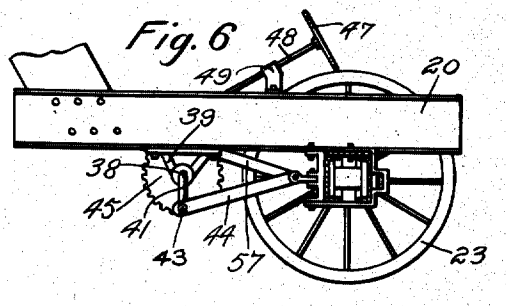
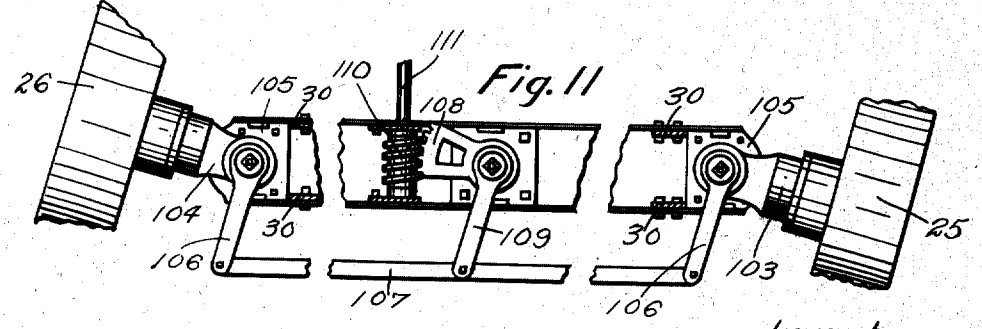


Fig. 11



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APPLICATION FILED JUNE 8, 1915.

1,279,853. **Patented Sept. 24, 1918.**

3 SHEETS—SHEET 3.

Fig. 12

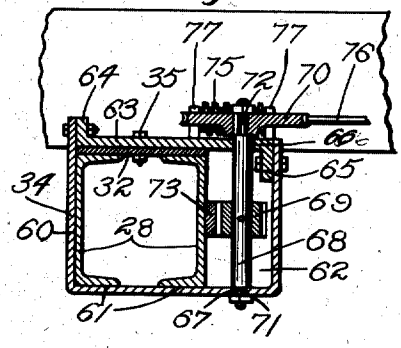


Fig. 10

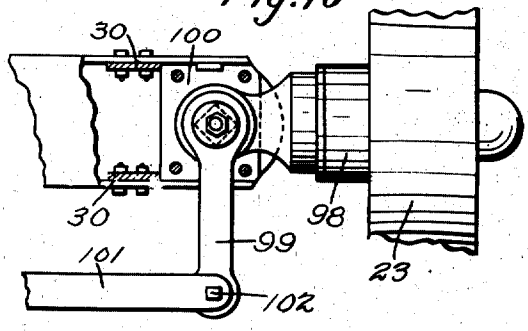


Fig. 13

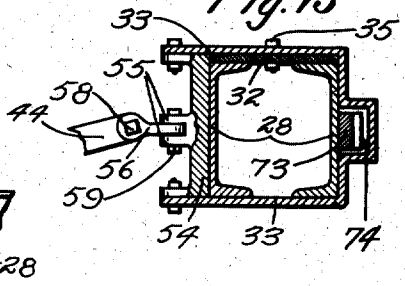


Fig. 8

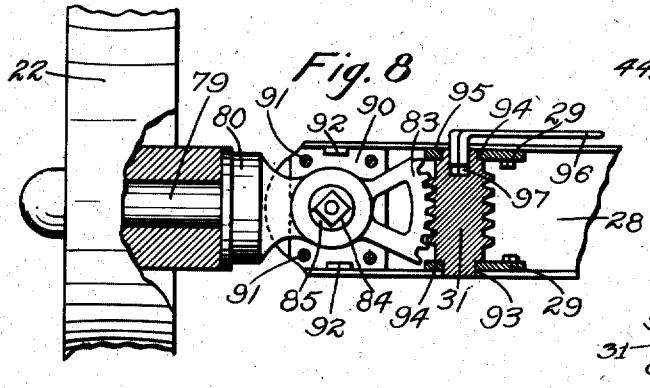


Fig. 14

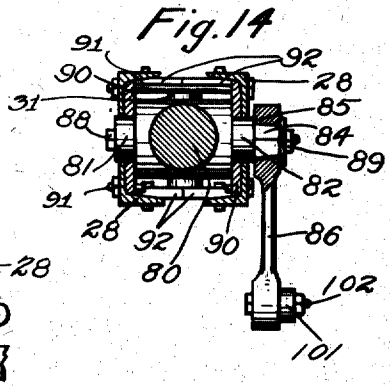
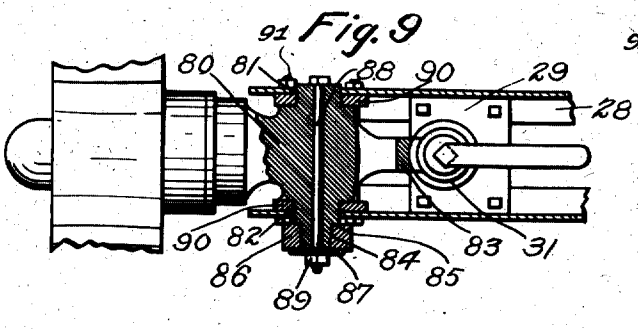


Fig. 9



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UNITED STATES PATENT OFFICE.

ELIAS K. ENEBO, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO STOCKLAND ROAD MACHINERY COMPANY, OF MINNEAPOLIS, MINNESOTA, A CORPORATION.

GRADING-MACHINE.

1,279,853. Specification of Letters Patent. Patented Sept. 24, 1918.

Application filed June 8, 1915. Serial No. 32,809.

To all whom it may concern:

Be it known that I, ELIAS K. ENEBO, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Grading-Machines, of which the following is a specification.

My invention relates to grading machines and has for its object to provide improved means of counteracting the component thrust on the wheels and axle of the grader when the scraper is in action and also to overcome the tendency of the grader to travel in a curved path instead of a straight one during the period when the scraper is in action. These results are accomplished by providing, in combination with the axle, means for sliding the axle and wheels laterally from one side to the other and for oscillating said axle and wheels jointly in a horizontal plane, means for tilting the wheels into planes obliquely disposed to both the horizontal and vertical planes of the wheel base. This combination of means comprises an organization effective to completely compensate for the downward and lateral thrusts when the machine is in operation, so as to hold the machine to its work and cause the line of travel to be straight and the power applied to be used most effectively in the moving of earth by the scraper.

The extended axle serves to make the reacting lever arm equal for both wheels so that the downward thrust, which is greatest at the remotest corner of the scraper, is equally distributed on both wheels. The wheel tilt overcomes the lateral thrust and the rear axle oscillation causes the grader to take a direct course, which it would not do unless it were oscillated, due to the fact that the front axle is of short span and that the lateral thrust comes on the rear part of the grader.

The full objects and advantages of my invention will appear in connection with the detailed description thereof and are particularly pointed out in the claims.

In the drawings, illustrating the application of my invention in one form,—

Figure 1 is a plan view of one form of my grader showing the application of my new tilting shifting and oscillating devices. Fig. 2 is an enlarged plan view of the rear axle and a portion of the frame with parts cut away showing the axle extended to its extreme position on the left. Fig. 3 is a rear elevational view of the portion of the machine shown in Fig. 2 with parts cut away and others shown in section. Fig. 4 is a plan view of the same portion of the grader as is shown in Fig. 2 with part of the axle cut away showing the axle extended to the left and oscillated to cause the left-hand wheel to precede the right-hand wheel. Fig. 5 is a rear end elevational view of the part of the grader shown in Fig. 3 with the axle extended to the left and the wheels tilted to the left. Fig. 6 is a fragmental side elevational view of the left side of the frame, rear wheels and axle of the grader showing the oscillating device. Fig. 7 is a similar view of the right side of the same with one wheel removed. Fig. 8 is an enlarged rear end view of a portion of the left-hand rear wheel and axle showing some parts broken away and others in section in order to expose some of the elements of my tilting device. Fig. 9 is a plan view of the parts shown in Fig. 8, some of them being cut away and others being shown in section. Fig. 10 is an enlarged rear end elevational view of a portion of the right-hand rear wheel and axle with one of the channel members of the axle partially removed in order to expose other elements of my tilting device. Fig. 11 is an enlarged front end view of the front axle and wheels with one of the channel members of the front axle entirely removed, showing my wheel-tilting device as applied to the front axle and wheels of my grader. Fig. 12 is an enlarged section through the rear axle taken on the line 12—12 of Fig. 2 showing in detail the device for producing the lateral shifting of the rear axle. Fig. 13 is an enlarged section through the rear axle taken on line 13—13 of Fig. 2 showing the method of guiding the axle and of attaching the connecting rod to the axle for producing the oscillation. Fig. 14 is an enlarged section through the rear axle on line 14—14 of Fig. 2 showing the method of attaching the cranks of the tilting device to the wheel shaft trunnions. Fig. 15 is a rear end section of the grader frame and accessories taken on the line 15—15 of Fig. 2 showing the cranks and crank shaft arrangement used in procuring the oscillation of the rear axle.

My grader as best shown in Fig. 1 is com-

prised of a frame 20 supported on a rear axle 21 carrying wheels 22 and 23 and on a front axle 24 carrying wheels 25 and 26, the said frame supporting a scraper 27 and all such adjusting and regulating devices as are ordinarily required on scrapers, including a platform 51 on which the operator stands while manipulating the devices controlling the grader as well as the devices for producing the oscillation of the rear axle and the shifting of the same, which said operations together with the tilting of rear and front axles will be presently described. The front axle oscillates in a horizontal plane about a pivot in its center, as is usually the case with such graders, the angle of oscillation being, however, very large. By my new device the rear axle can also be made to oscillate although merely through a small angle.

The rear axle of my grader is comprised of two channel beams 28 rigidly fastened together at the ends by means of castings 29 and 30 which are bolted to the flanges of said channels. Castings 29 serve also as bearings for a worm gear 31 which is part of the tilting device, while castings 30 serve only for the purpose of holding the beams together.

The method of securing the axle to the frame 20 is best shown in Figs. 2 and 3. The entire axle is arranged to slide in the direction of its length in a casing composed of the plate 32 and the three enveloping members 33 and 34. There are two members 33, one at each side of the frame 20, and a single member 34 is located intermediate the side members of the frame. The members 33 and 34 are secured to the plate 32 by bolts 35. The casing thus formed is prevented from having vertical motion by the lower flange of beams 28 and the castings 36, which castings are rigidly fastened to the plate 32 and overlap the guides 37, said guides being rigidly bolted to frame 20. The guides 37 and the castings 36 are arcuate, having as a center an imaginary pivot at the intersection of line 12—12 of Fig. 2 and the center of the axle, thus guiding the casing and axle to oscillate about this imaginary pivot when oscillatory motion is given thereto.

The oscillatory motion is given to the casing as follows: A shaft 38, located under the main frame 20 of the grader and somewhat in advance of the rear axle, has bearings 39 and 40 of the hanger type suspended from the lower flange of said frame 20 and bolted thereto. The shaft 38 has at one end a crank 41 fitted with a shoulder 42 and nut 43 to hold the connecting rod 44 in place. This shaft further has a worm wheel 45 on the other end rigidly keyed thereto. Worm wheel 45 is operated by a worm gear 46, which, as well as a hand wheel 47, are securely mounted on a shaft 48. The shaft 48 has a bearing 49 attached to the top flange of the beam 20 and a bearing 50 attached to the side of the same beam. Shaft 48 is so situated that hand wheel 47 extends above a platform 51 on which the operator is working to be within easy reach. The worm wheel 45 has a cap screw 52 screwed into it, said cap screw carrying a connecting rod 53, the arrangement serving as a crank, which crank has the same length of crank arm as 41 and is situated at an angle of one hundred and eighty degrees with respect thereto, as clearly shown in Fig. 15.

The enveloping members 33 of the casing containing rear axle 28 are shown in section in Fig. 13. Each of these members passes around the two channels 28 on three sides and has a casting 54 bolted to it on the fourth side, casting 54 serving as a connecting member for the band 33 and also having as an integral part the lugs 55 extending from the center. A link 56 such as used with universal joints, having two holes at right angles to each other, although in this case not in the same plane, carries the connecting rod 44 or 57, as the case may be, by means of a pivot bolt 58 and is pivotally fastened to the lugs 55 of the enveloping member by a bolt 59.

It can now be clearly seen from Figs. 2, 4, 6, 7 and 15 that when the cranks 41 and 45—52 are standing in a transverse vertical plane that the ends of the connecting rods 44 and 57 attached thereto are the same distance from such a plane, and furthermore the rear axle 28 and the surrounding casing are at right angles to the longitudinal direction of the grader frame, as is shown in Figs. 2, 6 and 7. It can be further seen that as the hand wheel 47 is revolved and the worm gear, wheel and cranks rotated, when the cranks 41 and 45—52 are in a horizontal plane, the end of one of the connecting rods is at a greater distance from such transverse vertical plane than the other, and hence the casing and rear axle have been oscillated and are situated angularly with respect to the grader frame 20, as shown in Fig. 4, the maximum oscillation in one direction having taken place in this position of the cranks. When the cranks are in this condition rotation of the hand wheel 47 in either direction will cause the casing and rear axle to be oscillated in the reverse direction, the extreme position being when the cranks are again in a horizontal plane but are in reversed positions. My invention, as has been shown, effectually provides a method of oscillating the rear axle any amount within the limits described and by means of the worm wheel and gear 45 and 46 of automatically locking the axle in the required position.

The rear axle 28, which is free to slide in the direction of its length within the casing

32, 33, 34, previously described, is constrained and caused to move in this casing by the mechanism now to be described. Figs. 2, 3, 4, 5 and 12 show it to the best advantage. Enveloping member 34, shown in section in Fig. 12, is a band surrounding the channeled rear axle 28 on two sides and the bottom, fitting closely to the rear axle 28 on the front 60 and the bottom 61, but leaving a space 62 on the rear side. The band 34 is bolted to a casting 63 having lugs 64 and 65 expressly for that purpose, said casting being rigidly fastened to plate 32 by means of the cap screws 35, which plate and casting form the top of the enveloping member. The casting 63 and the band 34 have holes 66 and 67, respectively, said holes serving as bearings for a shaft 68. Shaft 68 carries a pinion 69 pinned thereto and is driven by a worm wheel 70 keyed to said shaft. The portion 72 of shaft 68 on which the gear is fastened, as well as the other end at 71, is of smaller diameter and is threaded on the extreme end to receive a nut, the larger part of the shaft serving as a shoulder. The portion of shaft 68 at 72 is used to maintain the gear in a fixed position on said shaft, and the portion at 71 is used to keep the shaft from sliding longitudinally with respect to its bearings 66 and 67 and yet to rotate freely in them. Pinion 69 meshes with a rack 73 bolted to the side of the channel 28 and passing through the space 62 formed by the enveloping member 34. The shaft 68 and pinion 69 are also contained in the space 62, and the contact between the pinion and the rack tends to keep the axle 28 well toward the side 60. The rack 73 is somewhat long in order to give considerable range to the shifting device, so when the axle is at its extreme position, as shown in Fig. 5, the rack 73 extends beyond the enveloping member 33, and a chamber 74 is formed out of the band 33 in order to let the rack 73 pass through, as is well shown in Fig. 13. Worm wheel 70 is operated by a worm gear 75 pinned on shaft 76, said shaft 76 being journaled in bearings 77 which are an integral part of casting 63 and are so spaced as to just allow the worm gear to rotate between them, thus allowing the worm gear 75 and shaft 76 to rotate freely but not to slide longitudinally in the bearings 77. Shaft 76 extends beyond the rear member of the frame 20, as shown in Figs. 2 and 4, and has a hand crank and handle 78 attached thereto.

The longitudinal motion of the rear axle to shift the wheels from one side of the machine to the other is given to the axle by means of the hand crank and handle 78 through shaft 76, worm gear 75, worm wheel 70, shaft 68, pinion 69 and rack 73.

It can readily be seen that any shift within the limits determined by the length of rack and axle may be obtained; and furthermore the use of the worm wheel 70 and worm gear 75 render the mechanism locked in whatever position it is left. It will be further realized that the whole shifting mechanism, including the hand crank and handle 78, is oscillated when the axle is oscillated by the wheel 47, and that neither the plate 32 nor any part of the oscillating device is moved when the axle is shifted by the crank 78.

The device for tilting the wheels both for the front and rear axle is entirely independent of the oscillating or shifting device and is entirely confined to the axle. It is best shown in Figs. 2, 3, 4, 5, 8, 9, 10, 11 and 14. Fig. 11 shows a slightly modified form applicable to the front axle, so the preferred form, shown in the remaining figures, will be next taken up. Figs. 8, 9 and 14 show the left-hand mechanism. The portion 79 of the axle upon which the left-hand wheel 22 rotates is an integral part of a casting 80. The casting 80 is also supplied with trunnions 81 and 82 and the segment of a worm wheel 83. Trunnion 82 has a square extension 84 which is of such dimensions as to afford a shoulder 85. A crank arm 86 has a square hole which fits the square projection 84 of casting 80 and is held up against the shoulder of said casting 80 by means of a washer 87 and a bolt 88 which passes completely through the centers of the trunnions 81 and 82 and is secured by means of a nut 89. This renders the crank 86 very rigidly attached to casting 80, as is quite essential, due to the heavy lateral strains to which the wheels are subjected. Trunnions 81 and 82 are journaled in holes drilled in the channels 28 and plates 90 fastened thereto. Bolts 91 which fasten these plates to the channel beams 28 serve a double purpose since they also hold the two channel beams together. The plates 90 have projections 92 at right angles to them and of such a length as to reach to the middle of the axle so that when the channel beams 28 are in place the projections 92 on the opposite plates just meet. The bolts 91 pass completely through both channel beams and so help to hold the axle together. The worm wheel segment 83, which is part of the casting 80, meshes with the worm gear 31. Worm gear 31 is supplied with trunnions 93 and 95 of such size as to provide shoulders 94, which prevent the longitudinal motion of the worm gear and still allow it to rotate freely. Worm gear 31 is furthermore provided with a square hole 97 which acts as a receptacle for the handle 96 used in rotating said worm gear. The trunnions 95 and 93 of worm 31 are journaled in the castings 29, which castings are bolted to the flanges of the channel beams 28 and thereby also serve to hold the axle rigidly together as heretofore described,

The right-hand wheel 23, as best shown in Fig. 10, is mounted to rotate on a casting 98 identical with the casting 80 of the left-hand wheel except that the worm wheel segment 83 is missing. Casting 98 carries a crank 99 and is journaled in the channel beams 28 and plates 100 in an identical manner with casting 80. Cranks 99 and 86 are connected by a connecting link 101 by means of bolts 102 which serve as pivots.

The wheels 22 and 23, as is readily comprehended from the previous description, are tilted by means of the worm wheel segment 83, the worm gear 31 and the handle 96, the tilt of wheel 22 being given to wheel 23 through the cranks 99 and 86 and the connecting link 101, which cranks and connecting link always keep the planes of the wheels parallel. In revolving the worm gear 31 the handle 96 is only partly inserted in the hole 97. When the handle 96 is allowed to reach the bottom of hole 97 it falls in between the flanges of channels 28 and lies flush with the tops of said flanges, serving as a second lock for the tilting device. This device is subject to so many and so severe jolts that the mere worm wheel and gear locking device will hardly be sufficient, as the same under such conditions will be caused to revolve and so change the angle of tilt. The minimum adjustment is hence limited to that obtained by a quarter of a revolution of the worm gear, but for all occasions that is sufficient.

The application of my tilting device to the wheels of the front axle is best shown in Fig. 11. A right-hand casting 103 and a left-hand casting 104, identical with casting 98 of the rear axle, support and permit to rotate the wheels 25 and 26. The said castings are journaled in plates 105 and have fastened to them crank arms 106, which in turn are connected by a connecting link 107, all quite similar to the application to the rear axle. The main difference, however, is in the segregation of the worm wheel and gear from the wheel shaft or support. The arrangement will be clearly seen in the previously mentioned Fig. 11. A worm wheel segment 108 is trunnioned and has secured to it a crank 109, which is also pivoted on connecting rod 107. The journals and fastenings are identical with those of the rear axle, and worm wheel segment and trunnions are identical with worm wheel 83 and casting 80, not having the wheel shaft for support, as clearly shown. Worm wheel segment 108 meshes with a worm wheel 110, which with its bearings and fastenings is identical with worm gear 31 except that it may have a shaft 111 supplied instead of the handle 96. The operation of the device is identical with that applied to the rear axle, and the modification is only necessary in order to have the shaft 111 in the center of the front axle, or in the vicinity of the king bolt, as becomes necessary when the tilt is to be given to the front wheels by means in reach of the operator on the platform 51 situated at the rear of the grader. The device for transmitting the motion from the rear platform to the shaft 111 is not shown. In case this transmission is not desired the handle 96 can be substituted for the shaft 111 and the modified form of mechanism used for either or both axles. Due to the greater simplicity I prefer the former method.

I claim:

1. A grader comprising a frame, arcuate guides secured at corresponding positions on the said frame, an axle supporting said frame, a casing within which said axle is slidably mounted, arcuate members secured to said casing for engagement with said arcuate guides, a shaft supported by said frame, a crank arm on one end of said shaft, a connecting rod pivotally attached at one end to said crank arm and the other end of which is pivotally connected to said casing, a worm wheel on the other end of said shaft, a crank member on said worm wheel positioned at an angle of one hundred eighty degrees with relation to said crank arm, a connecting rod pivotally attached at one end to said crank member the other end of which is pivotally connected to said casing, a shaft mounted on the said frame and extending upwardly therefrom, a hand wheel on one end of said shaft, a worm on the other end thereof in mesh with said worm wheel and a supporting wheel on each end of said axle.

2. A grader comprising a frame, arcuate guides secured at corresponding positions on said frame, an axle supporting said frame, said axle comprising two spaced beams secured together near their ends by castings, a casing within which said axle is slidably mounted, arcuate members secured to said casing for engagement with said arcuate guides, a shaft supported by said frame, a crank arm on one end of said shaft, an operating connection between said crank arm and said casing, a gear on the other end of said shaft, a crank member on said gear positioned at an angle of one hundred eighty degrees with relation to said crank arm, an operating connection between said crank member and said casing, means for turning said gear, a rack member on said axle, a shaft mounted on said casing, a pinion secured to said shaft and meshing with said rack, means for turning said shaft, a gear mounted between the aforesaid beams in the castings which are near one end of said beams, a member trunnioned in one end of said beams, a segmental gear fixed on said member in mesh with said gear, a supporting wheel carried by said trunnioned member, a second member trunnioned in the other end of said beams, a supporting wheel

carried by said trunnioned member and means for turning both of said trunnioned members in unison.

3. A grader comprising a frame, arcuate guides secured at corresponding positions on the inner portions of the side members of said frame, an axle supporting said frame, said axle comprising two spaced beams secured together near their ends by castings, a casing within which said axle is slidably mounted, arcuate members secured to said casing for engagement with said arcuate guides, a shaft supported by said side members, a crank arm on one end of said shaft, a connecting rod pivotally mounted at one end on said crank arm and the other end thereof pivotally connected to said casing, a worm wheel on the other end of said shaft, a crank member on the said worm wheel positioned at an angle of one hundred eighty degrees with relation to said crank arm, a connecting rod pivotally mounted at one end on said crank member and the other member thereof pivotally connected to said casing, a shaft mounted on said frame and extending upwardly therefrom, a hand wheel on one end of said shaft, a worm on the other end thereof in mesh with said worm wheel, a rack member on one of the beams of said axle, a shaft mounted on said casing, a pinion secured to said shaft and meshing with said rack, a worm wheel secured to said shaft, a second shaft mounted on said casing, a worm on one end of said shaft meshing with said worm wheel, a handle on the other end of said shaft, a worm mounted between the aforesaid beams in the castings which are at one end of said beam, a member trunnioned in one end of said beams, a segmental worm wheel fixed on said member in mesh with said worm, a supporting wheel carried by said trunnioned member, a second member trunnioned in the other end of said beams, a supporting wheel carried by said trunnioned member, cranks secured to each of said trunnioned members, a connecting rod pivoted to each of said cranks, and a handle for turning said last mentioned worm.

In testimony whereof I affix my signature in presence of two witnesses.

ELIAS K. ENEBO.

Witnesses:
F. A. WHITELEY,
H. A. BOWMAN.