Sept. 28, 1926. 1,601,510

J. B. RHODES

ROAD GRADING MACHINE

Filed Jan. 16, 1920 4 Sheets-Sheet 1

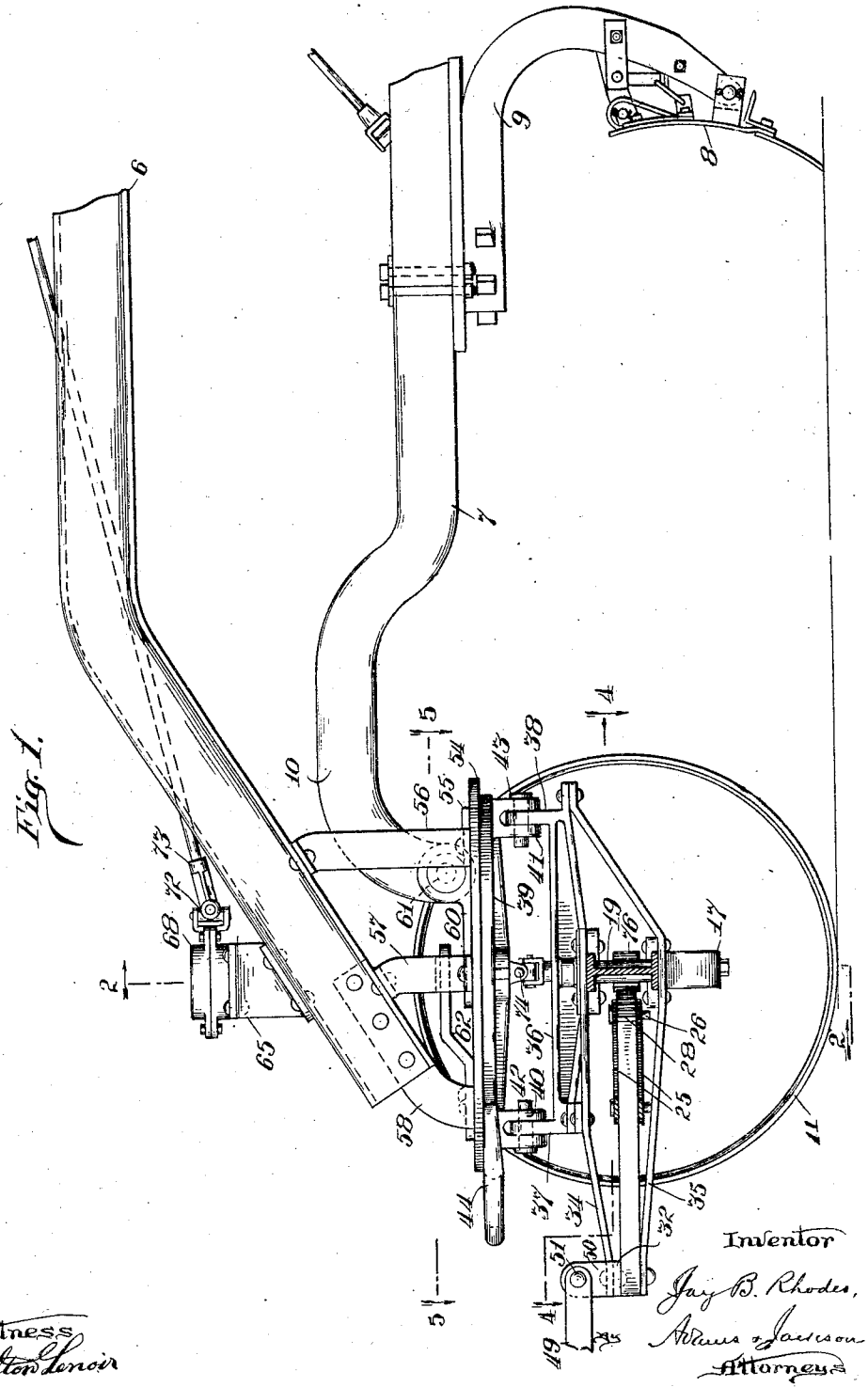


Fig. 1.

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Filed Jan. 16, 1920 4 Sheets-Sheet 2

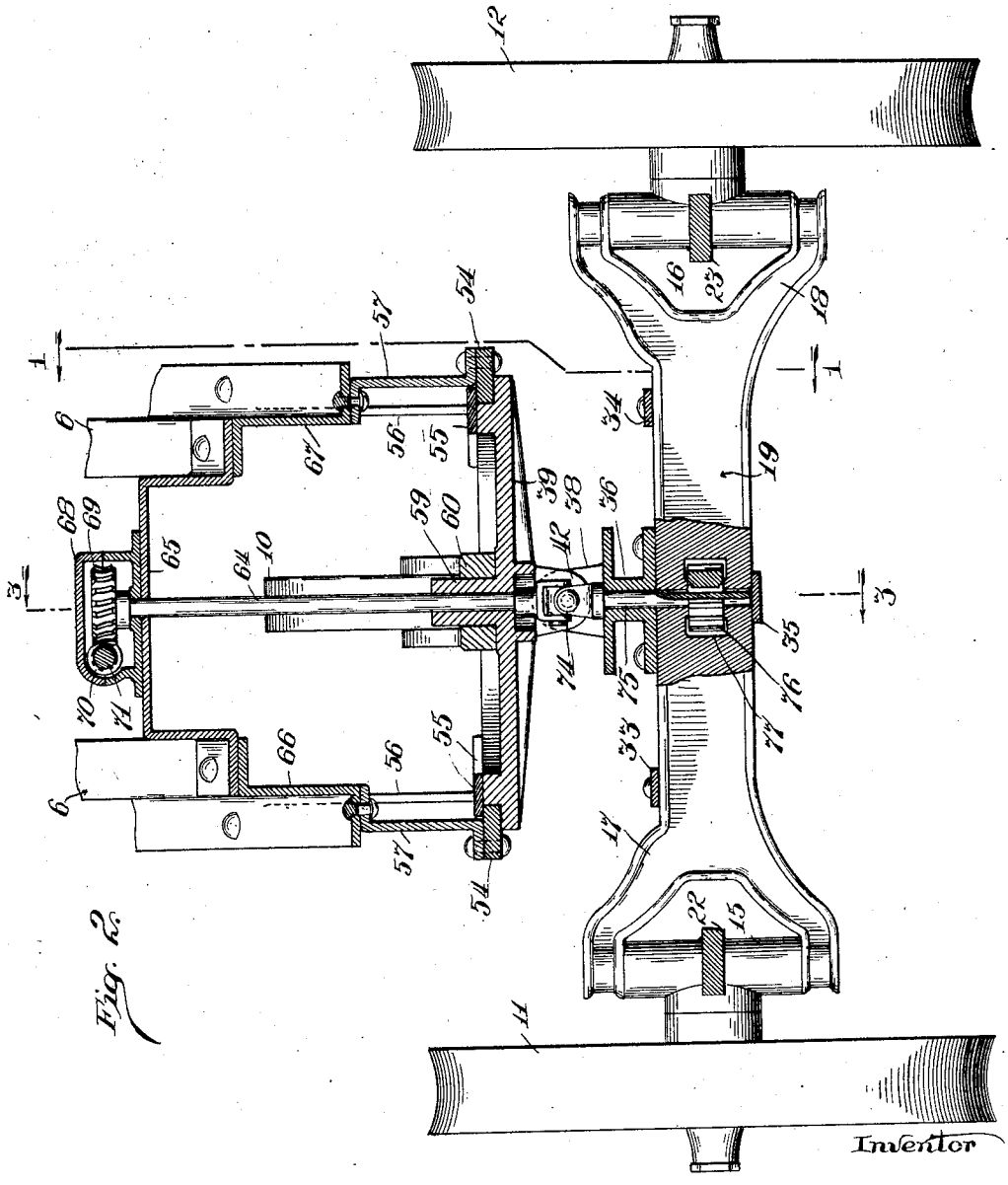


Fig. 2.

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ROAD GRADING MACHINE

Filed Jan. 16, 1920 4 Sheets-Sheet 5

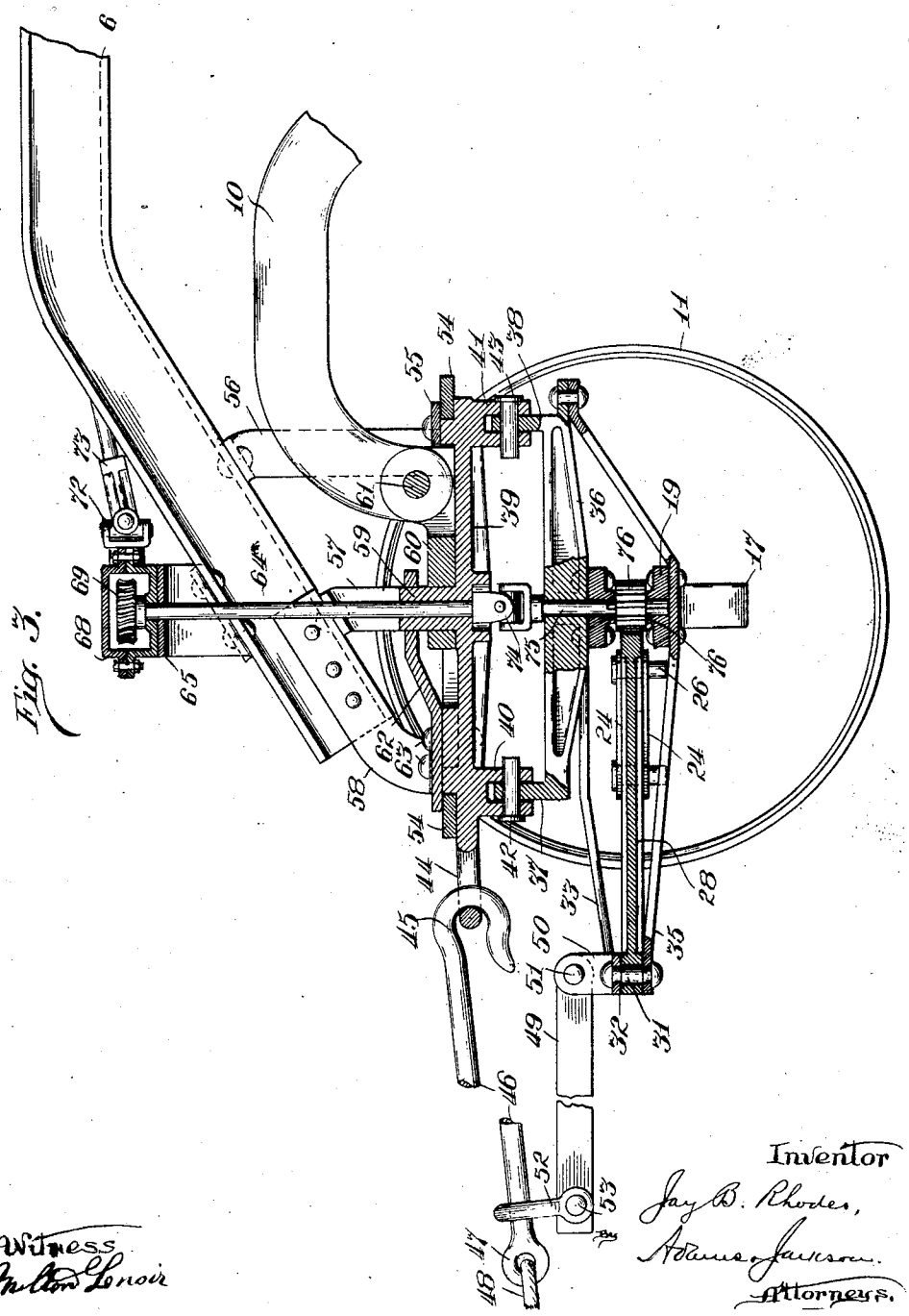


Fig. 5.

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ROAD GRADING MACHINE

Filed Jan. 16, 1920 4 Sheets-Sheet 4

Fig. 5.

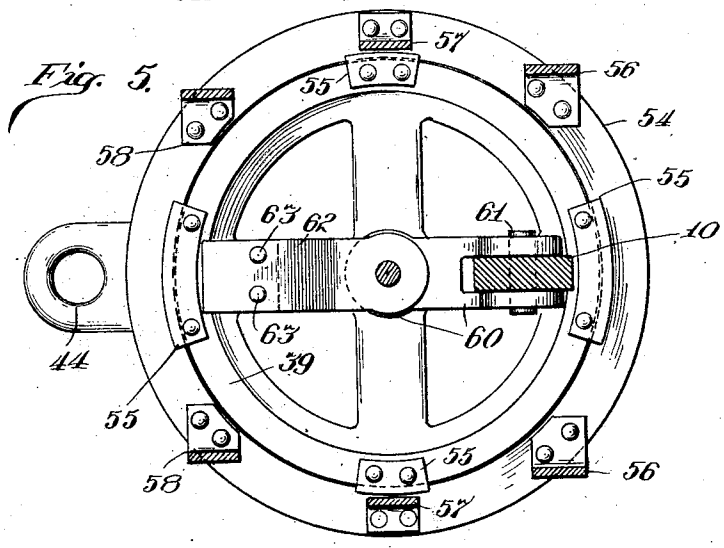
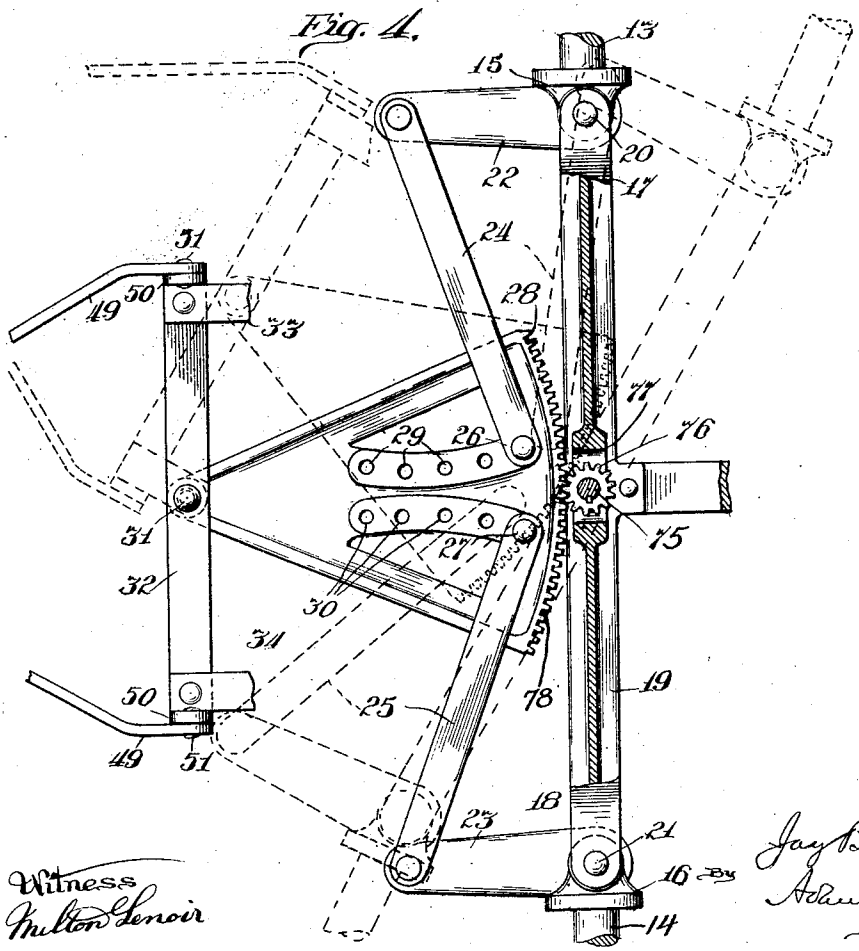


Fig. 4.



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UNITED STATES PATENT OFFICE.

JAY B. RHODES, OF KALAMAZOO, MICHIGAN, ASSIGNOR TO WESTERN WHEELER SCRAPER COMPANY, OF AURORA, ILLINOIS, A CORPORATION OF ILLINOIS.

ROAD-GRADING MACHINE.

Application filed January 16, 1920. Serial No. 351,974.

My invention relates to road making machinery, and has for its object to provide a new and improved grading machine especially adapted for use as a trailer to be drawn by a traction engine. In operating such machines they are usually hitched to the traction engine by a long cable, which sometimes is as much as sixty feet long, to permit the traction engine to run on or at one side of the crown of the road while the grading machine travels in the ditch at the opposite side of the crown from that where the traction engine is traveling. Under such conditions there is a strong lateral pull on the grading machine which makes it very difficult for the operator to hold it properly to its work, and this is intensified by the rough going which usually obtains in a wayside ditch. Furthermore, it is frequently necessary in operating a grading machine to project the scraper laterally away from the road bed to cut down a bank, and this further increases the difficulty of steering under the conditions above mentioned, so that frequently the work of steering under such conditions with grading machines as heretofore constructed is practically beyond human endurance.

Again, in the work of steering a trailing grader on the roadway as distinguished from in the ditch, inequalities in the surface of the road, or curves of the road, deflect the line of draft to one side or the other, and this is particularly true in turning corners, so that there is a constant tendency to swing the front wheels to one side or the other, which, in machines as heretofore constructed, makes steering difficult and burdensome. The improvements which form the subject-matter of my present invention provide means by which the difficulties above mentioned are to a large extent, if not completely, overcome, and the grading machine may be steered comparatively easily even under the most exacting conditions. The nature of such improvements is specifically pointed out in the following description of the construction illustrated in the accompanying drawings, which illustrate the preferred embodiment of my invention. What I regard as new is set forth in the claims.

In the accompanying drawings,—

Fig. 1 is substantially a side elevation of the front portion of a road grading machine embodying my invention, being a longitudinal vertical section on line 1—1 of Fig. 2;

Fig. 2 is an enlarged vertical cross-section on line 2—2 of Fig. 1;

Fig. 3 is a longitudinal vertical section on line 3—3 of Fig. 2;

Fig. 4 is a horizontal section on line 4—4 of Fig. 1; and

Fig. 5 is a horizontal section on line 5—5 of Fig. 1.

In the drawings I have illustrated only such parts of a road grading machine as are necessary to a full understanding of my invention, and it should be understood that the drawings are intended to illustrate the application of my improvements to a grading machine of a standard type, comprising a wheeled frame under which is disposed the usual angularly and vertically adjustable scraper blade, the various adjustments of which are effected by the usual operating devices mounted on the grader frame. The machine may also be provided with an endwise and angularly adjustable rear axle. These features are all old and well-known to those familiar with the art so that it is not believed to be necessary to illustrate or describe them at this time.

Referring now to the drawings,—6 indicates the main frame of the grader, 7 the scraper supporting frame, and 8 the scraper blade, which is connected to the frame 7 by a bifurcated curved beam 9 and the usual rotary connecting devices so that the scraper blade may be angularly and otherwise adjusted in the usual way. The frame 7 has the usual goose-neck 10 at its forward end by which it is connected to the draft devices, as will be hereinafter described.

11, 12 indicate the front wheels, which are mounted, respectively, on spindles 13, 14 carried by vertical sleeves 15, 16 which fit in the bifurcated end portions 17, 18 of a dirigible front axle 19, as best shown in Fig. 2, and are pivotally supported by vertical pivots 20, 21, as best shown in Fig. 4. Thus the front wheels may be turned angularly with reference to the axle 19 for steering the machine, the construction in this respect being similar to that used in connection with automobile vehicles of various kinds, except that the axle 19 also is pivoted to swing horizontally. The sleeves 15, 16 are provided with steering arms 22, 23 rigid there-

with and projecting forward therefrom, preferably at a right angle, as shown in Fig. 4. The steering arms 22, 23 are not connected directly together by a rigid cross-connection, as is the case in automobile construction, but they are adjustably connected by links 24, 25 and pins 26, 27 with a segmental rack 28, as shown in Fig. 4, said rack being provided with two arcuate series of holes 29, 30, extending generally fore and aft, to receive the pins 26, 27. The segmental rack 28, therefore, forms an adjustable intermediate connection between the inner ends of the links 24, 25 and not only provides for adjusting the "cut" of the wheels so that the grader will trail with the tractor when using cables of different lengths, but also for swinging the arms 22, 23 simultaneously in one direction or the other to guide the machine in the manner hereinafter described. The forward portion or apex of the segmental rack 28 is mounted on a vertical pivot 31 fitted centrally in a cross-bar 32 which forms part of a rigid steering frame connected with the front axle 19. This frame comprises two parallel side bars 33, 34, the rear end portions of which are secured to the upper side of the axle 19, as shown in Fig. 2, while their forward end portions are secured to the cross-bar 32; also a longitudinally-extending bar 35, the forward end portion of which is secured by the pivot 31, as shown in Fig. 3. This bar 35 extends under the axle 19, to which it is secured, and then extends rearward and upward where it is connected to the rear end portion of a longitudinally-extending beam 36 mounted centrally upon and secured to the axle 19, as shown in Figs. 2 and 3. The beam 36 is provided at its ends with upturned lugs 37, 38 for the pivotal connection therewith of the lower member 39 of a fifth wheel or draft frame, this connection being accomplished by providing the frame 39 with downwardly extending bifurcated lugs 40, 41 which fit upon the lugs 37, 38 to which they are connected by pivots 42, 43, as shown in Fig. 3. Thus the frame 39 is capable of rocking laterally upon the beam 36. The forward portion of the frame 39 is provided with a draft ring or eye 44 adapted to receive a hook 45 at the rear end of a draft rod 46, as shown in Fig. 3. This draft rod, which is comparatively long, has an eye 47 at its forward end for the connection therewith of a draft cable 48, which may be of any desired length, and serves to connect the draft rod 46 with any source of power, such as a traction engine.

The forward portion of the steering frame heretofore described is provided with a tongue 49, as shown in Fig. 3, the rear end of said tongue being connected with the cross-bar 32 by means of a lug 50 carried centrally by said cross-bar and connected with said tongue by a pivot 51. The forward portion of the tongue 49 is connected loosely with the draft rod 46 by a hook 52 which is connected with the tongue by a horizontal pivot 53 and hooks over the steering rod 46, as shown in Fig. 3. By this construction, when the draft rod 46 is swung laterally in either direction by deflection of the line of draft the tongue 49 will be swung in the same direction, thereby correspondingly turning the front axle. The effect of this adjustment upon the front wheels will be explained later on.

The forward portion of the grader frame 6 is supported upon the draft frame 39 by means of a ring plate 54 which forms the upper member of the fifth wheel and is fitted to turn upon the upper marginal portion of the draft frame 39, as shown in Fig. 3. The ring plate 54 is held in position by a series of clips 55 secured to the upper surface of the draft frame 39, and overlapping the inner marginal portion of the ring plate 54, as shown in Figs. 3 and 5. 56, 57, 58 indicate standards connecting the forward portion of the grader frame 6 with the ring plate 54. 59 indicates a tubular bearing which rises centrally from the draft frame 39 and serves to connect the forward portion of the goose-neck 10 with said draft frame, this connection being effected by means of a connecting bar 60 which is pivoted upon the bearing 59 and extends rearwardly over the draft frame 39 to the forward end of the goose-neck 10 to which it is connected by a horizontal pivot 61, as shown in Fig. 3. Thus the draft frame 39 may swing about a vertical axis independently of the scraper frame 7, and the latter frame may swing vertically about the pivot 61 independently of the draft frame 39. The bearing 59 is braced by a brace 62 which fits over its upper end portion and is fixedly connected with the forward portion of the draft frame 39 in any suitable way, as by rivets 63, shown in Fig. 5. The steering mechanism comprises a vertical shaft 64, the lower end portion of which is fitted in the bearing 59 while its upper end portion extends through a cross-bar 65 secured to the forward end portions of the members 66, 67 of the grader frame 6, as shown in Fig. 2, and extends into a housing 68 mounted on said cross-bar 65. At its upper end the shaft 64 carries a worm wheel 69 which meshes with a worm 70 carried by a longitudinally extending shaft 71 which is coupled by a universal joint 72 to a steering rod 73 which runs back to the driver's seat where it is provided with the usual steering wheel. The worm steering gear is of the irreversible type so that the shaft 64 can be rotated only by operation of the steering wheel. At its lower end the shaft 64 is connected by a universal joint

74 with a shaft 75 which is fitted in bearings in the beam 36 and axle 19 so that it may rotate independently thereof, and in the same plane with the segmental rack 28 the shaft 75 carries a pinion 76 which is keyed to said shaft so that it rotates therewith. This pinion is mounted in a recess 77 provided centrally in the axle 19 so that it is intersected by the shaft 75, as best shown in Figs. 2 and 3. It is apparent that by rotating the shaft 64 the shaft 75 and pinion 76 will be similarly rotated. The toothed portion 78 of the segmental rack 28 meshes with the pinion 76, as shown in Figs. 3 and 4, and consequently the rotation of the shaft 75 operates to adjust the segmental rack 28 laterally with relation to the axle 19, and thereby, through the steering links 24, 25 and arms 22, 23, operates to adjust the angular position of the front wheels.

The operation of my improved machine is as follows: When the draft is straight away the front wheels may be steered in the ordinary way by turning the hand steering wheel in the appropriate direction, thereby rotating the pinion 76 and swinging the rear end of the segmental rack 28 accordingly, which as has been explained, correspondingly swings the steering arms 22, 23 and turns the front wheels toward one side or the other. If, however, the hand steering wheel is not rotated, the pinion 76 will be locked against rotation because of the irreversible character of the worm gearing connected with the shaft 64, and, therefore, if the forward portion of the segmental rack 28 is not swung laterally by the deflection of the line of draft the front wheels will maintain their position. If, however, the line of draft be deflected, as to the right, the steering frame will be swung in a clockwise direction as viewed in Fig. 4, thereby correspondingly turning the front axle 19 toward the position indicated by dotted lines in said figure. Bearing in mind that this turning of the front axle does not rotate the pinion 76, which remains stationary unless the hand steering wheel is turned, it will be apparent that the rack teeth 78 will ride over the teeth of the pinion 76, and, therefore, the rear end portion of the segmental rack 28 will be moved to the left relatively to the axle 19, as viewed in Fig. 4. The result of this operation will be to swing the steering arms 22, 23 in a counterclockwise direction as viewed in said figure, thereby turning the front wheels so that they tend to run toward the left, or in opposition to the deflecting tendency of the altered line of draft. In other words, if the new line of draft turns the front axle toward the right, the front wheels will be turned to run to the left of a direction perpendicular to the axle, and, therefore, tend to direct the machine more nearly straight ahead. Consequently in turning a corner, for example, the machine would automatically turn in a comparatively large arc. This automatic action can, of course, be supplemented or modified by operation of the hand steering wheel, so that the machine is capable of negotiating curves or corners without difficulty. The advantage of my improved construction in operating in ditches where the traction engine runs on or beyond the crown of the road will also be readily appreciated, since the lateral deflection of the line of draft away from the ditch automatically turns the steering wheels in the opposite direction, or toward the bank, so that the machine can easily be held in operative position, and the operator is enabled to force the scraper blade against the bank and hold it there without difficulty. The extent to which the wheels are automatically deflected may be varied, so that the grader will trail with the tractor when using cables of different lengths, by adjusting the position of the links 24, 25 with relation to the segmental rack 28 by shifting the pins 26, 27 into one or another of the series of holes 29, 30.

So far as I am aware, the steering mechanism shown and described is generically new, as I know of no prior machine having means for automatically controlling the steering wheels in the manner described, and the claims hereinafter made are, therefore, to be construed accordingly.

What I claim as my invention and desire to secure by Letters Patent, is—

1. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices, and means controlled thereby for turning said wheels laterally with respect to the axle and in the opposite direction to that in which the axle is turned.

2. A grading machine comprising a main frame, a pivoted front axle, wheels pivotally connected with said axle to swing laterally, draft devices, and means automatically operating when the line of draft is laterally deflected for relatively turning said wheels in the opposite direction.

3. A grading machine comprising a main frame, a pivoted front axle, wheels pivotally connected with said axle to swing laterally, draft devices, and means automatically operating when the line of draft is laterally deflected for turning said axle in the same direction and relatively turning said wheels in the opposite direction.

4. A grading machine comprising a main frame, dirigible front wheels, draft devices, means automatically operating when the line of draft is laterally deflected for relatively turning said dirigible wheels in the opposite direction, and means for independently steering said wheels.

5. A grading machine comprising a main frame, a pivoted front axle, wheels pivotally connected with said axle to swing laterally, draft devices, means automatically operating when the line of draft is laterally deflected for relatively turning said wheels in the opposite direction, and means for independently steering said wheels.

6. A grading machine comprising a main frame, a pivoted front axle, wheels pivotally connected with said axle to swing laterally, draft devices, means automatically operating when the line of draft is laterally deflected for turning said axle in the same direction and relatively turning said wheels in the opposite direction, and means for independently steering said wheels.

7. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices, means actuated by lateral deflection of the line of draft for turning said axle laterally, and mechanism connected with said steering wheels and operated automatically by the turning of said axle for swinging said wheels laterally with reference to the axle and in the opposite direction to that in which the axle is turned.

8. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices connected with said main frame, a steering frame connected with said axle and with said draft devices so that lateral deflection of the line of draft deflects said steering frame, and means automatically operated by the turning of the axle for swinging said wheels laterally in the opposite direction.

9. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices connected with said main frame, a steering frame connected with said axle and with said draft devices so that lateral deflection of the line of draft deflects said steering frame, means automatically operated by the turning of the axle for swinging said wheels laterally in the opposite direction, and means for independently steering said wheels.

10. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices, steering means connected with said axle and operated by lateral deflection of the line of draft, a transversely movable rack carried by said steering means and connected with said wheels, a pinion meshing with said rack, and means independent of the axle for holding said pinion against rotation.

11. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices, steering means connected with said axle and operated by lateral deflection of the line of draft, a transversely movable rack carried by said steering means and connected with said wheels, a pinion meshing with said rack, and manually operated steering mechanism connected with said pinion, said steering mechanism comprising means for holding said pinion against rotation when the axle is turned about its axis.

12. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing lateraly, draft devices, steering means connected with said axle and operated by lateral deflection of the line of draft, a transversely movable rack carried by said steering means and connected with said wheels, a pinion meshing with said rack, and manually operated steering mechanism connected with said pinion, said steering mechanism comprising irreversible worm gearing for normally holding said pinion against rotation when the axle is turned about its axis.

13. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices connected with said main frame, a steering frame connected with said axle and adapted to be guided by the draft devices, a laterally swinging segmental rack mounted on said steering frame, a pinion having its axis in alinement with the axis of said axle and meshing with said segmental rack, means connecting said segmental rack with said wheels, and means for holding said pinion against rotation when the axle is swung on its pivot.

14. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices connected with said main frame, a steering frame connected with said axle and adapted to be guided by the draft devices, a laterally swinging segmental rack mounted on said steering frame, a pinion having its axis in alinement with the axis of said axle and meshing with said segmental rack, means connecting said segmental rack with said wheels, and manually operated means for rotating said pinion independently of the axle.

15. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices connected with said main frame, a steering frame connected with said axle and adapted to be guided by the draft devices, a laterally swinging segmental rack mounted on said steering frame, a pinion having its axis in alinement with the axis of said axle and meshing with said segmental rack, means connecting said segmental rack with said wheels, and man-

ually operated means for rotating said pinion independently of the axle, said manually operated steering means comprising irreversible worm gearing.

16. A grading machine comprising a main frame, a pivoted front axle, wheels pivotally connected with said axle to swing laterally, draft devices connected with said main frame, a steering frame connected with said axle and adapted to be guided by the draft devices, a laterally swinging segmental rack mounted on said steering frame, a pinion having its axis in alinement with the axis of said axle and meshing with said segmental rack, and means adjustably connecting said segmental rack with said wheels.

17. A grading machine comprising a main frame, a pivoted front axle, wheels pivotally connected with said axle to swing laterally, draft devices connected with said main frame, a steering frame connected with said axle and adapted to be guided by the draft devices, a laterally swinging segmental rack mounted on said steering frame, a pinion having its axis in alinement with the axis of said axle and meshing with said segmental rack, manually operated means for rotating said pinion independently of the axle, and adjustable means connecting said segmental rack with said wheels, whereby the extent to which said wheels are turned by deflection of the line of draft may be varied.

18. A grading machine comprising a main frame, a fifth wheel supporting the forward portion of said main frame, a dirigible axle supporting said fifth wheel, a steering shaft in alinement with the axis of said fifth wheel, wheels dirigibly mounted on said axle, and means operatively connected with said shaft for turning said wheels laterally with relation to the axle either by the draft of the team or by rotation of said shaft.

19. A grading machine comprising a main frame, a fifth wheel supporting the forward portion of said main frame, a dirigible axle supporting said fifth wheel, a steering shaft in alinement with the axis of said fifth wheel, wheels dirigibly mounted on said axle, a pinion connected with said steering shaft, a pivotally mounted rack meshing with said pinion, and means connecting said rack with said steering wheels whereby said wheels may be steered by the rotation of said steering shaft.

20. A grading machine comprising a main frame, a fifth wheel supporting the forward portion of said main frame, a dirigible axle supporting said fifth wheel, a steering shaft in alinement with the axis of said fifth wheel, wheels dirigibly mounted on said axle, a pinion connected with said steering shaft, a segmental rack meshing with said pinion, means connecting said segmental rack with said steering wheels whereby said wheels may be steered by the rotation of said steering shaft, and a frame rigidly connected with the axle and pivotally supporting said rack.

21. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, a steering frame rigidly connected with the axle and extending forward therefrom, a tongue connected with said steering frame, a draft frame mounted on said axle, a draft rod connected with said draft frame and having a guiding engagement with said tongue, and means operated by lateral movement of said steering frame for swinging said wheels laterally on the axle.

22. A grading machine comprising a main frame, a dirigible front axle, a fifth wheel mounted upon said axle and supporting said main frame, said fifth wheel being adapted to rock about a longitudinal axis, dirigible wheels carried by said axle, a pinion carried by the axle, means connecting said pinion with said dirigible wheels whereby said wheels may be steered by the rotation of said pinion, and manually operated steering mechanism mounted on said main frame and connected with said pinion.

23. A grading machine comprising a main frame, a front axle, dirigible wheels carried by said axle, steering mechanism mounted on said main frame and operatively connected with said dirigible wheels, a draft frame comprising a fifth wheel member, said fifth wheel member being adapted to turn on a horizontal axis with respect to the axle, and about a vertical axis with respect to said main frame, and means for connecting said draft frame with the axle.

24. A grading machine comprising a main frame, a front axe, dirigible wheels carried by said axle, steering mechanism mounted on said main frame and operatively connected with said dirigible wheels, a draft frame comprising a fifth wheel member, said fifth wheel member being adapted to turn on a horizontal axis with respect to the axle, and about a vertical axis with respect to said main frame, means for connecting said draft frame with the axle, and a scraper frame pivotally connected with said draft frame.

25. A grading machine comprising a main frame, a dirigible front axle, dirigible wheels carried by said axle, steering mechanism mounted on said main frame and operatively connected with said dirigible wheels, a draft frame comprising a fifth wheel member, said fifth wheel member being adapted to turn on a horizontal axis with respect to the axle, and about a vertical axis with respect to said main frame, and means for connecting said draft frame with the axle.

26. A grading machine comprising a main frame, a dirigible front axle, dirigible wheels

carried by said axle, steering mechanism mounted on said main frame and operatively connected with said dirigible wheels, a draft frame comprising a fifth wheel member, said fifth wheel member being adapted to turn on a horizontal axis with respect to the axle, and about a vertical axis with respect to said main frame, means for connecting said draft frame with the axle, and a scraper frame pivotally connected with said draft frame.

27. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, and draft controlled means operatively connected with said axle and operable to swing the axle laterally and to turn said wheels laterally with respect to the axle and in the opposite direction to that in which the axle is swung.

28. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft controlled means connected with the axle and operating by lateral deflection of the line of draft to turn the axle relatively to the main frame, and means connected with said wheels and actuated by lateral deflection of the draft devices to turn said wheels laterally with respect to the axle and in the opposite direction to that in which the axle is turned.

29. A grading machine comprising a main frame, a dirigible front axle, wheels pivotally connected with said axle to swing laterally, draft devices, means operatively connected with said axle and actuated by lateral deflection of the line of draft for turning said axle laterally, and mechanism connected with said steering wheels and operated automatically by the turning of said axle for swinging said wheels laterally with reference to the axle and in the opposite direction to that in which the axle is turned.

JAY B. RHODES.

Certificate of Correction.

It is hereby certified that the name of the assignee in Letters Patent No. 1,601,510, granted September 28, 1926, upon the application of Jay B. Rhodes, of Kalamazoo, Michigan, for an improvement in "Road-Grading Machines," was erroneously written and printed as "Western Wheeler Scraper Company," whereas said name should have been written and printed as *Western Wheeled Scraper Company*, as shown by the records of assignments in this office; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of October, A. D. 1926.

[SEAL.]

WM. A. KINNAN,
Acting Commissioner of Patents.