March 16, 1937. J. S. BURNS 2,074,081

ROAD GRADING MACHINE

Filed Oct. 30, 1934 4 Sheets-Sheet 1

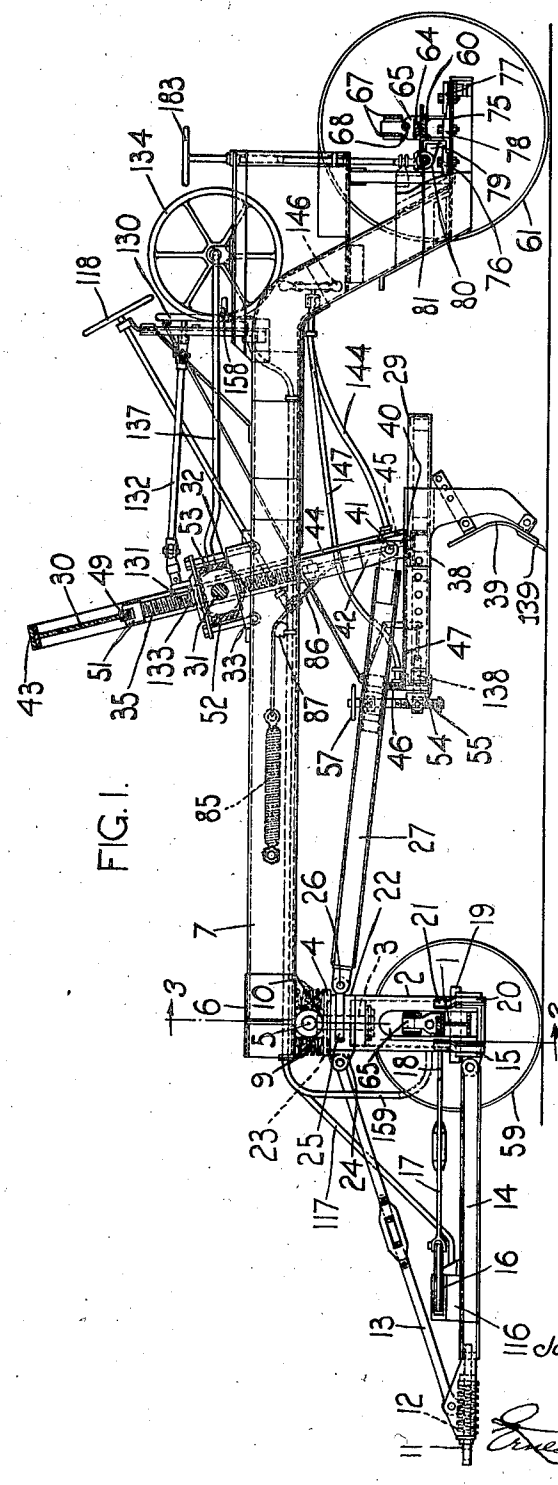


FIG. 1.

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ROAD GRADING MACHINE

Filed Oct. 30, 1934 4 Sheets-Sheet 2

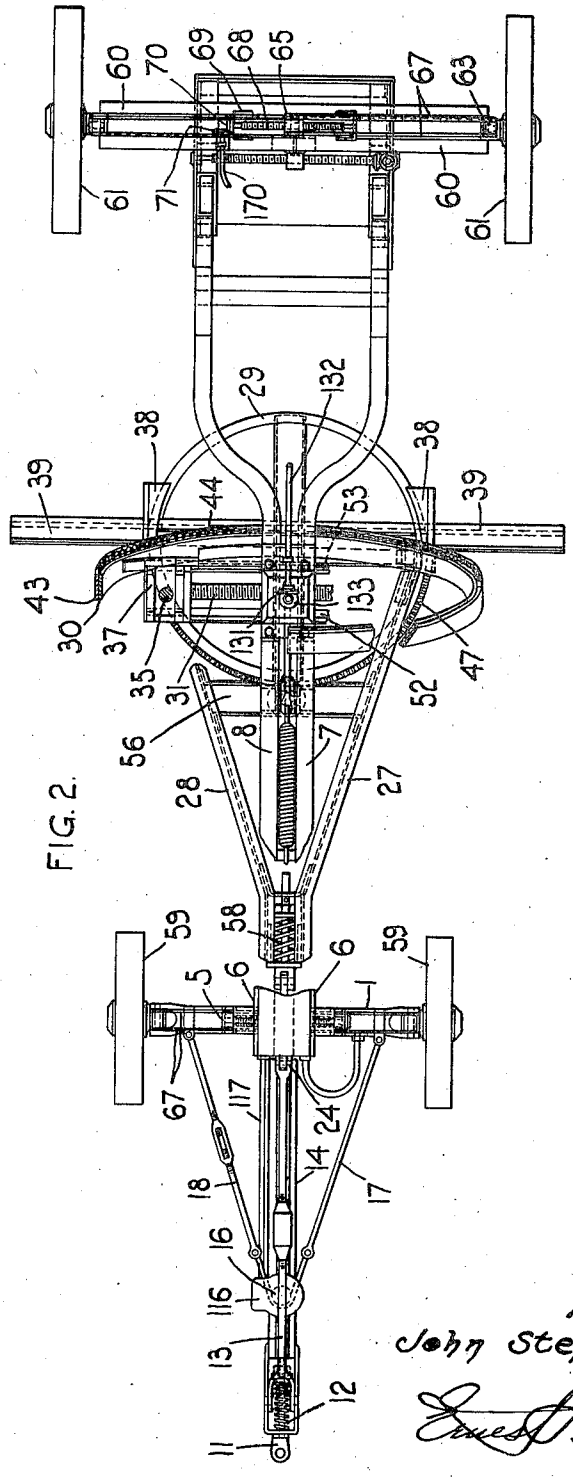


FIG. 2.

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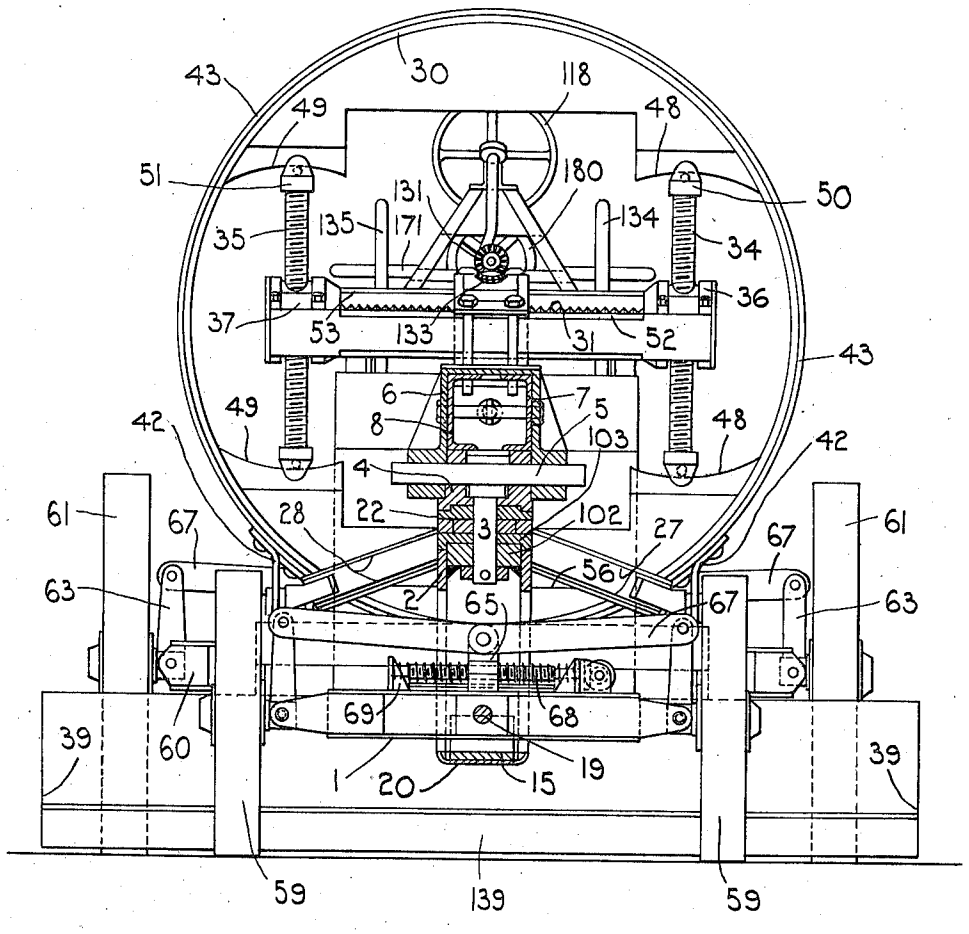
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March 16, 1937. J. S. BURNS 2,074,081

ROAD GRADING MACHINE

Filed Oct. 30, 1934 4 Sheets-Sheet 3

FIG. 3.



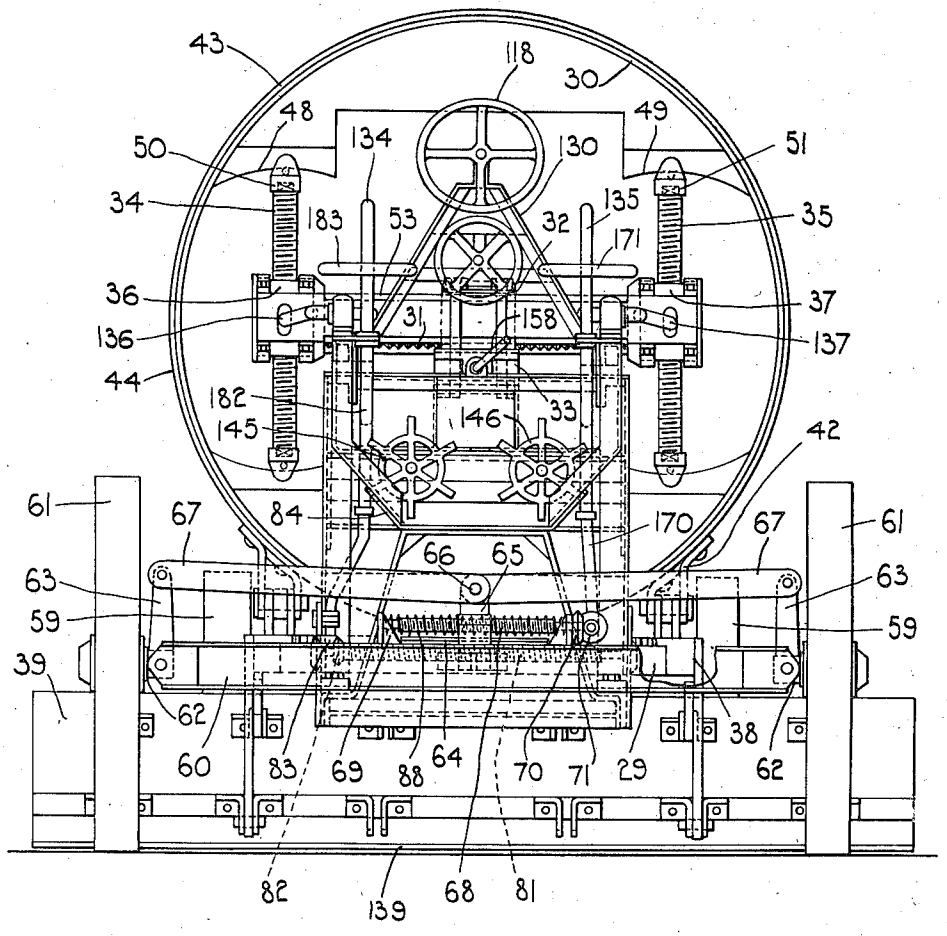
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ROAD GRADING MACHINE

Filed Oct. 30, 1934 4 Sheets-Sheet 4

FIG. 4.



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UNITED STATES PATENT OFFICE

2,074,081

ROAD GRADING MACHINE

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Application October 30, 1934, Serial No. 750,693
In Great Britain November 30, 1933

14 Claims. (Cl. 37—157)

This invention relates to grading machines with more especial reference to road graders for making earth or gravel roads in which a blade is adjustably mounted on a steerable vehicle so as to be capable of cutting the soil and imparting the desired profile to the surface traversed or passed by the machine.

In machines of this character as hitherto constructed, the plough frame has been of general A shape with its apex attached to the front of the grader—usually the king bolt or steering head—and mounting at its rear the draft circle, plough circle, plough arms, mould board and blade, the position of the plough frame being controlled through two gear boxes operating cranked rods with adjustable lifting links which fix the angle and in the vertical plane the effective depth of cut accomplished by the blade of the machine in operation and by another gear box operating a sliding arm with movable link in the lateral plane.

Side shifting or the lateral movement of the plough frame with its components results in loss in the depth of cut and the positioning of the blade for side cuts is only effected with difficulty and with consequent alteration in the depth of cut, while when the blade is in this position undesirable stress concentration results during use of the machine. Moreover, the known machines are by no means foolproof, though the controls are independent the resultant movement consequent on any one control being restricted by the setting of the others, and it being thus possible to lock or jam the blade in adjustment.

The present invention has for its object to provide an improved construction of grading machine having an increased range of positions for the blade and wherein setting of the blade to any position within its range may be readily effected while the stresses contingent on use will be more appropriately distributed and the wear on the parts minimized, the likelihood of ultimate fracture being correspondingly reduced.

Further and favorable objects will appear from the following description.

In accordance with the present invention the plough frame mounting the circle to which the blade is attached is carried by a cone-like structure normally disposed in the longitudinal axis of the machine, such structure being movable about its apex for setting the plough blade to give the desired side shift, inclination, or depth of cut.

Preferably also the circular base of the cone-like structure is universally pivoted to the main frame, the structure being arranged with its virtual apex at the anchorage of the draw bar by which the plough frame is drawn, and provision being made by means of appropriate gear boxes and screw-threaded stems for lateral and/or vertical bodily movement of the circular base of the cone in relation to the main frame to alter the set of the blade.

The plough frame and draft circle, about which the plough circle mounting the blade is adjustable in the usual manner, is mounted on an annular rim encircling the circular base of the cone and movable thereabout to set the blade to the desired inclination of cut, this assembly giving a range of adjustment for the blade from a cutting position occupying the vertical at one side of the machine to a similar position at the other side.

Particular advantage accrues from the use of the circular or cone-like structure as a mounting for the plough frame, since all movements thereof whether vertical for setting the depth of cut, lateral according to the extent of side cut required or inclination to give the desired profile, can each be had quite independently of the others, in contradistinction to existing arrangements of grader where, owing to the adjustments being effected through link and lever mechanism, any adjustment in the vertical direction modifies the lateral set of the blade as a matter of course and vice versa.

Wherever possible, it is desired to use irreversible screw-threaded stems actuated by gear boxes to produce movements of the parts within the range of permissible positions for the blade, since this method of actuation prevents unnecessary transmission of stress and permits of the control shafts being taken to the platform from the respective gear boxes as light flexible cables, or telescopic rodding and universal couplers.

A further aspect of the invention resides in the provision of a front axle steerable about a central pillar pivotally connected to the frame of the vehicle so as to permit movement of the axle in the longitudinal plane, compression springs or other cushioning devices maintaining the central pillar or cushioning head in its normal position.

Longitudinal flexibility is thereby obtained and the likelihood of machines being damaged or deteriorated when traversing uneven surfaces is avoided.

The invention will be further described with reference to the accompanying explanatory drawings which illustrate one embodiment thereof, and in which,—

Fig. 1 is a longitudinal view of the grader partly in section showing the controls, Fig. 2

being a plan of the grader shown in Fig. 1 also partly in section, the operator's platform and control mechanism having been removed more clearly to show the mechanism for adjusting the lean or rake of the rear wheels.

Fig. 3 is a front elevation partly in section and with the draw gear removed, and Fig. 4 is a rear view showing the operator's platform and the hand and foot wheels by which the position of the plough blade may be adjusted at will.

Referring now to the drawings, but first more especially to the front carriage illustrated in Figs. 1, 2 and 3, a rigid front axle 1 of general H-section is carried in a slotted tubular steering column 2, rotation of which, for steering the grader to follow its tractor, takes place about a vertical pin 3 depending from a platform 4, itself pivotal in a vertical plane about a transverse pin 5 borne in bracket castings 6 secured at the front end of the main frame constituted by longitudinal girders 7 and 8.

In contradistinction to the semi-rigidly mounted front carriages hitherto employed in machines of this character, the embodiment of grader illustrated employs a flexible front carriage relieving the grader frame of bending moment when traversing uneven surfaces, the central steering column 2 carried by the platform 4 being permitted movement in the vertical longitudinal plane of the grader about the transverse pin 5 against appropriate resistances shown as helical springs 9 and 10 by which the tubular column is normally retained in and returned to its vertical position relative to the frame.

Moreover, the rigid front axle 1 is pivoted for limited angular vertical movement in relation to the tubular column 2 on a cotter pin 19, whereby the front wheels readily accommodate themselves to transverse inequalities without subjecting the main frame of the grader to torsion.

A triangular draw bar assembly is provided for connecting the grader with its tractor, a draw stirrup 11 equipped with the usual draft cushioning spring 12 being provided at the front of a bifurcated draw arm, of which one adjustable arm 13 links—through a collar 22 hereafter described—with the upper end of the tubular column 2, the other arm 14 passing horizontally to a collar 15 at the foot of the tubular column 2 in the vicinity of the front axle 1, the flexible mounting of the front carriage permitting it automatically to follow the rise or fall of the tractor when passing over uneven ground and its stability being at all times assured by the aforementioned compression springs or other cushioning devices 9 and 10 which tend to return the tubular column to its normal vertical position.

Steering thrusts are distributed from a sprocket or pulley 16 adjacent the front of the draw bar assembly to points in the vicinity of the ends of the front axle by floating and adjustable tie rods 17 and 18.

Associated with the sprocket or toothed pulley 16 is a worm and worm wheel irreversible gear box 116 connected by a flexible shaft 117 with a steering wheel 118 located above the platform at the rear of the grader, rotation of the steering wheel 118 altering the relative position of the front axle 1 and the tubular column 2 in relation to the main draw arms 13 and 14, whereby the operator may accurately steer the grader on a desired course in wake of its tractor.

The pin 19 by which the front axle 1 is pivoted to the tubular column 2 is notched exteriorly of the tubular column 2 and is locked in position by the upper edge of the collar 15 occupying the notches, the collar 15 being in turn secured against displacement, while being permitted say 60° angular movement, by a stirrup clip 20 which provides a bottom cover for the tubular column 2 and which has fingers 21 extending up the sides of said column and secured thereto by bolts.

The vertical steering pin 3 is locked in position in the inverted platform 4 by its head engaging the transverse bearing pin 5, while in the top of the tubular column 2 is welded in a head 102 with an upwardly projecting circular boss 103 providing a seat for a correspondingly circular recess in the aforementioned collar 22.

The collar 22 is provided with a similar upstanding circular boss 23 providing a seat for a recess in the inverted platform 4 and is furnished with a frontal lug 24 to which the draft arm 13 is pinned and is split or bifurcated to provide a pair of rearwardly directed jaws between which is positioned a bearing or plough draft collar 25 also encircling the steering pin 3, the bearing collar 25 mounting at its rear a horizontal pin 26 to which the draft arms 27 and 28 of the plough frame and the draft circle 29 are pivoted.

Reference will now be had also to Fig. 4 in describing the circular cone-like structure mounting the said plough frame and draft circle 29. Essentially such structure comprises a circular base 30 which is not only pivotal about the axis of a horizontal screw-threaded stem 31 mounted in a gear box 32, in turn rotatable in a plane at right-angles to the plane of the base 30 upon an inclined bracket 33 secured to the main frame members 7 and 8, but said circular base 30 is also movable laterally, vertically and to a limited degree in rotation by means of the aforementioned lateral screw-threaded stem 31 actuated through its gear box 32 and by approximately vertical screw-threaded stems 34 and 35 actuated by gear boxes 36 and 37 in the manner hereafter described.

The plough frame comprised of draft arms 27 and 28 and draft circle hereafter generally designated 29, about which is rotatable the plough circle 38 carrying the mould board 39 and blade 139, is furnished at each end of its transverse diameter with a pair of upstanding lugs 40 in which are pins 41 by which the draft circle 29 is connected to the draft arms 27 and 28 and to brackets 42 on an annular frame 43 surrounding and movable about the circular base 30.

The lower half of this annular frame or great circle 43 is furnished with internal gear teeth 44 with which teeth enmeshes a spur wheel 45 appropriately borne in the circular base 30, a flexible shaft 144 connecting the spur wheel 45 with an operating wheel 145 adjacent the platform.

Rotation of the wheel 145 imparts rotary movement to the great circle 43 about the circular base 30, and since the plough frame and draft circle 29 mounting the plough circle 38 and mould board 39 and blade 139 is carried by this great circle 43, there is a corresponding bodily movement of the plough frame and blade about the centre of the circular base 30.

A similar wheel 146 is connected through a flexible shaft 147 to a spur wheel 46 borne in the draft circle of the plough frame and enmeshing with gear teeth 47 furnished for the purpose of rotating the plough circle 38.

Readily releasable pawls, not shown, or bolts 138, may engage the gear teeth of the circles 38

and 43 to fix them in adjusted positions, and it will be understood that the angular set of the blade 39 may be modified at the will of the operator by movement of the wheel 145 without affecting the incidence of cut set by the wheel 146, movement of which latter similarly modifies the incidence of the blade without affecting the angle of cut determined by the position of the annular frame or great circle 43.

As aforementioned, final adjustments in the set of the blade and depth of cut can be accurately made through the gear boxes 36 and 37 on the vertical stems 34 and 35 which, when moved in unison, produce a bodily movement of the circular base 30 but which are also independently movable through hand wheels 134, 135 connected respectively to the gear boxes 36, 37 by flexible shafts 136, 137.

When either the gear box 36 or the gear box 37 is actuated independently of the other, the set of the blade is altered owing to movement of the circular base 30 about the stationary gear box, and to permit of this independent movement of the stems 34 and 35 arcuate guides 48 and 49 on the circular base 30 slidably mount yoke-shaped bearing blocks 50 and 51 at the ends of the respective stems 34 and 35, the guide blocks being rigidly or otherwise connected to the stems in such manner as to prevent them from turning.

To relieve the transverse stem 31 of bending moment, the gear boxes 36 and 37 are mounted on and secured to transverse guide members 52 and 53 located respectively in front of and behind the gear box 32 and slidable in transverse guideways therein in consonance with the movements imparted to the transverse stem 31.

Bodily lateral movement of the circular base 30 by projection of the transverse stem 31 through its gear box 32 is had from a hand wheel 130 rotating a bevel wheel 131 through a flexible universal shaft 132, the bevel 131 enmeshing with the second bevel 133 appropriately borne in the cover of the gear box 32.

The internal construction of the gear boxes 32, 36 and 37 is similar, each including a nut engaging its respective screw-threaded stem 31, 34 or 35, which nut is provided with suitable thrust bearings in the gear box and has secured to it or is formed integrally with a bevel wheel rotated from the respective hand wheel by a corresponding bevel, which, in the case of the gear box 31, is mounted on the shaft of the bevel wheel 133, while in the case of the gear boxes 36 and 37 is clutched to the flexible shafts 136, 137 rotated by the respective hand wheels 134, 135.

The draft circle of the plough frame 29 has three-point suspension, since, in addition to the brackets 40 on its transverse diameter, it has a front bracket 54 which is shown adjustably borne on a screw-threaded spindle 55 mounted in a transom 56 bridging the draft girders 27 and 28 of the plough frame, a small hand wheel 57 serving for the adjustment of the stem 55 to alter the rake of the draft circle of the plough frame 29.

The draft gear also includes the usual cushioning spring 58 in rear of the pin 26, the girders 27 and 28 and the transom 56 forming a rigid triangular assembly universally connected to the steering pin 3.

Provision is also made for adjusting the rake of the wheels to suit the contour of the ground traversed, but in contradistinction to previous constructions of grader where toothed racks have been employed for this purpose, it is preferred to employ screw-threaded stems which may readily be encased in dustproof covers, and which, moreover, effect an irreversible drive thereby preventing unnecessary transmission of stress to the operating gear.

Referring more particularly to the rear view of the machine shown in Fig. 4, it will be seen that the rear axle designated 60, at each end of which the rear wheels 61 are mounted on stub axles 62 having bell-crank arms 63, is furnished on its upper surface with a guideway 64 along which is slidable a nut member 65, this nut member carrying a pin 66 to which are connected links 67 in turn pivoted to the bell crank lever 63 of the stub axles mounting the rear wheels.

Transverse movement of the nut member 65 from its normal central position in which the rear wheels are vertical is effected through a screw-threaded stem 68 carried above the axle 60 in bearings 69, one end of the stem 68 projecting through its bearing 69 and mounting a bevel wheel 70 enmeshed with a corresponding bevel wheel 71 connected through a flexible shaft 170 with a hand wheel 171.

Rotation of the hand wheel 171 thus imparts rotation to the screw-threaded stem 68 and causes bodily lateral movement of the nut member 65 along the axle 60 movement of the nut acting through the links 67 and the bell crank arm 63 to impart the desired rake or lean to the rear wheel 61.

Similar leaning wheel mechanism is furnished for the front axle 1, as clearly shown in Fig. 3, to which mechanism the same reference numbers have been applied and the rake of the front wheels, designated 59, is set through independently controlled gear for such front wheels by a handle 158 and flexible shaft 159.

In some cases it may be desirable or convenient, e. g. to avoid the spoil from the blade 139, to offset the rear wheels 61 in relation to the frame of the grader, and the embodiment illustrated provides rear axle shifting mechanism to this end.

By reference to Figs. 1, 2 and 4, it will be seen that the rear end of the grader frame is constructed as a platform 75 slung under the rear axle 60, which is slidable transversely in relation to the platform 75 in guideways formed by bearing blocks 76 and 77 in front of and behind the axle 60 and projecting over the lower webs thereof, a spacing block 78 being secured to the platform 75 and fixing the relative distance between the opposed channel frames constituting the rear axle 60.

Secured in any appropriate manner, e. g. by bolts, to the front channel of the axle 60, is a bracket 79 including a nut 80 which rides on a screw-threaded stem 81 borne in thrust bearings on the grader frame and having keyed at one end a bevel wheel 82.

Enmeshed with the bevel wheel 82 is a second bevel wheel 83 connected through a flexible shaft 182 to a hand wheel 183, rotation of the hand wheel 183 thus imparting rotation to the screw-threaded stem 81 and thereby transversely shifting the nut 80 and with it the axle 60 in regard to the main frame or platform 75.

It will be understood that the leaning wheel mechanism, being mounted directly on the axle 60 and being operated through a flexible shaft 170, is unaffected by bodily shift of the axle and vice versa, while since both shift and rake of the rear wheels are effected through irreversible transmissions, i. e. screw-threaded stems, there

is consequent self locking in any adjusted position.

The load operated against when reducing the lean of the wheels may be partially compensated by compression springs **88** which store energy on effecting lean and employ it when the action is reversed.

As is clearly shown in Figs. 1 and 2, the main frame is splayed in rear of the gear box **30** and is swept downwardly in front of the rear axle to the platform **75**, the splayed portion carrying a suitable platform **84** of sheet metal for the operator or driver, over which platform the various control wheels are conveniently grouped, the wheels **145** and **146** controlling respectively the position of the annular frame or great circle **43** and of the plough circle **38** which are adjacent the upper surface of the platform being furnished with projecting spokes so as to be readily foot-operated.

When moving the blade to any required position only light pressure is necessary on the hand wheels, and to assist in the bodily upward movement of the circular base **30** and plough frame by means of the large hand wheels **134, 135** operating the screw-threaded stems **34** and **35** through the gear boxes **36** and **37**, a tension spring **85** may be disposed in the rectangular space between the frame members **7** and **8** and may be connected to the circular base **30** by a flexible link **86** running over a guide **87** so as to exert an upward pull on the plough frame counteracting the weight of the latter to some extent.

The transverse pin **5** mounting the front carriage is shown projecting at each side of the brackets **6** and thus provides a suitable anchorage for a scarifier where it is desired to employ the machine with such an implement.

The manifold advantages of the improved grader will be apparent to those skilled in the art, particularly advantageous features of the embodiment described being as follows:—

1. The three point suspension with floating front axle removes all running stresses from the grader frame, the whole front assembly being permitted movement in the longitudinal plane against the resistance of the spring cushions **9** and **10**, while the front axle is pivoted on the pin **19** for limited vertical angular movement in regard to the column **2**.

2. Draw stresses are transmitted direct to the plough frame and draft circle **29** through the steering pin **3** in double shear, the collar **25** to which the draft girders **27** and **28** are connected being disposed between the two jaws of the collar **22**. The main frame is thereby further relieved of stress.

3. All movements of the blade **39** originate from the common centre, i. e. the centre of the circular base and normally of the transverse stem **31** positioned in the central gear box, it being impossible for any two movements to conflict and jam.

4. All movements of the blade are independently controllable without inter-action, there being no loss of cut on side shift.

5. The common centre is itself movable in a rectangle limited only by the range of adjustment afforded by the lateral stem **31** and the vertical stems **34** and **35**, the specific embodiment illustrated giving a rectangle 2′ wide by 18″ deep, although this can be varied.

6. In addition to bodily movement of the common centre angular movement of the blade **139** from a set position up to the vertical at one side of the machine to a similar position at the other can be had through the revoluble annulus or great circle **43**.

7. Final adjustments in the set of the blade and depth of cut can be accurately made on the vertical stems **34** and **35** by means of the hand wheels **134, 135**.

8. The normal movement of the plough circle **38** enables the blade incidence to be varied at will, and also may be usefully employed to facilitate shifting of the blade for angular side cuts.

9. Wheel rake for both axles and lateral shift for the rear axle is obtained through screw-threaded stems by irreversible drive rendering wheels and axles self-locking in any adjusted position.

10. Standard gear boxes may be used throughout and may be operated from the platform through flexible cables, since self-locking transmissions are used with two exceptions (*a*) the plough circle, and (*b*) the great circle, both of which are readily locked with pivoted pawls.

11. Unnecessary transmission of stress in the controlling gear is avoided and the screw-threaded stems are relieved of substantially all bending moment.

It will be understood that in place of the rotating nuts in the gear boxes **32, 36, 37**, the necessary movements of the circular base **30** could be had through gear boxes rotating the stems **31, 34, 35** in stationary nuts. Moreover, where desired, the vertical stems **34, 35** can be relieved of transverse thrust or bending moment by jacks bridging their gear boxes **36** and **37** and the circular base **30**, or guides, similar to the guides **52** and **53**, may be provided also for the gear boxes **36** and **37**.

A flexible shaft may be connected to the stem **55** whose hand wheel **57** can then be positioned adjacent the platform, whereby all movements of the blade can be effected without the operator having to dismount from his platform.

It will also be understood that while the embodiment of grader illustrated is adapted to be towed by a suitable tractor, the invention is also applicable to self-propelled vehicles or maintainers, in which case the floating front axle assembly would be replaced by a rigid axle equipped with steerable wheels and the draft girders **27, 28** would be pivoted directly to the frame of the grader near its front end instead of to the steering pin.

What I claim is:—

1. In a grading machine, a main frame mounted on wheels, a ring member mounted on and encircling the main frame, a plough frame with mould board and blade suspended from said member, means for revolving said member with the plough frame about the main frame and means for moving the centre of revolution of said member relatively to the main frame.

2. A grading machine including a main frame mounted on wheels, a member mounted on and encircling the main frame, a plough frame with mould board and blade suspended from said member, means for revolving said member about the main frame and means for moving it vertically in regard thereto, whereby to position the blade.

3. A grading machine including a main frame mounted on wheels, a member mounted on and encircling the main frame, a plough frame with mould board and blade suspended from said

member, means for revolving said member about the main frame, means for moving it vertically and means for moving it laterally in regard thereto, whereby to position the blade.

4. A grading machine including a main frame mounted on wheels, a member mounted on and encircling the main frame, a plough frame with mould board and blade suspended from said member, guide means for transmitting stress from said member to the main frame, means separate therefrom for moving said member laterally in regard to the frame, means for moving it vertically in regard thereto, and means for revolving it about the main frame.

5. A grading machine including a main frame mounted on wheels, a circular member mounted about the middle of said main frame and encircling same, a plough frame suspended from said member, means for effecting revoluble movement of said member in regard to said main frame and means for effecting independent vertical and transverse movement thereof whereby all movements of the blade are independently controllable without inter-action.

6. In a grading machine, a main frame mounted on wheels, a circular structure mounted on and encircling the main frame, means for bodily moving said structure relatively to the main frame, an annular member revolubly mounted on said structure and spaced from said main frame, a plough frame with mould board and blade suspended from said member and means for revolving said member with the plough frame about the main frame.

7. A grading machine including a main frame mounted on wheels, a circular structure located approximately midway of the frame and encircling same, means for effecting vertical movement of the structure and means for effecting transverse movement of the structure, an annular member revolubly mounted on said structure, a plough frame suspended from said member and means for revolving said member about the structure.

8. In a grading machine, a main frame mounted on wheels, a steerable fore carriage to said main frame, a plough frame with mould board and blade, draft arms on said plough frame coupling it with said fore carriage, and means for suspending said plough frame from the main frame and for moving it vertically, laterally and revolubly in regard thereto, including a ring member, brackets on said ring member to which said plough frame is directly pivoted the ring member being spaced from but revolubly and movably mounted on and encircling the main frame.

9. A grading machine according to claim 7, wherein the means for effecting revoluble movement of said member comprises a spur wheel mounted on said circular structure and enmeshed with gear teeth furnished on said member, and a flexible shaft connecting the spur wheel with an operating device.

10. A grading machine including a main frame mounted on wheels, an operator's platform to said main frame, a steerable fore carriage to said main frame, a member mounted on and encircling the main frame, a draft circle suspended from said member, a plough circle with mould board and blade carried by said draft circle, draft arms coupling said draft circle with said fore carriage, means for angularly setting the plough circle relative to the draft circle, means for revolving said member about the main frame, means for moving it vertically and means for moving it laterally in regard thereto, said means all being operable from said platform whereby to position the blade.

11. In a grading machine, a main frame mounted of wheels, a circular structure mounted on and encircling the main frame, means for moving said structure to and from the axis of the frame, guide means carried by said structure for transmitting stress from it to the main frame, an annular member revolubly mounted on said structure, a plough frame with mould board and blade suspended from said member and means for revolving said member with the plough frame about the main frame.

12. In a grading machine, a main frame mounted on wheels, a circular structure located approximately midway of the frame and encircling same, means for mounting the structure on the main frame including lateral and vertical screw stems and gear boxes for moving said structure laterally and vertically, guide means slidably connecting said structure with said stems for transmitting stress from said structure to the main frame, an annular member rotatably mounted on said structure, a plough frame suspended from said member and means for revolving said member about the structure.

13. A grading machine according to claim 12, wherein the means for mounting the circular structure on the main frame comprises a bearing furnished on the main frame approximately midway between the front and rear wheel axles, a gear box carried by said bearing and mounting a transverse screw-threaded stem, secondary gear boxes at each end of said stem mounting approximately vertical screw threaded stems providing a four-point carriage for the circular structure and transverse guide members engaged in said gear boxes to relieve the transverse stem of bending moment, said structure being moved laterally by operation of the gear box for the transverse stem and vertically by operation of the secondary gear boxes for the vertical stems respectively to modify the lateral disposition of the plough blade and its depth of cut.

14. A grading machine according to claim 12, wherein the means for mounting the circular structure on the main frame comprises a bearing furnished on the main frame approximately midway between the front and rear wheel axles, a gear box carried by said bearing and mounting a transverse screwthreaded stem, secondary gear boxes at each end of said stem mounting approximately vertical screwthreaded stems having at each end yoke-shaped bearing blocks engaging arcuate guide blocks of said structure, the bearing blocks being connected to the stems in such manner as to prevent them from turning, and transverse guide members engaged in said gear boxes to relieve the transverse stem of bending moment, said structure being movable laterally by operation of the gear box for the transverse stem, vertically by operation to equal extents and in like manner of the two secondary gear boxes for the vertical stems, and to a limited degree in rotation by operation to unequal extents or in opposite manner of said secondary gear boxes, whereby to set the position of the plough blade.

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