Oct. 25, 1955 A. W. GARDNER 2,721,405

ROLLER FOR LAND GRADING MACHINE

Filed Jan. 28, 1954 4 Sheets-Sheet 1

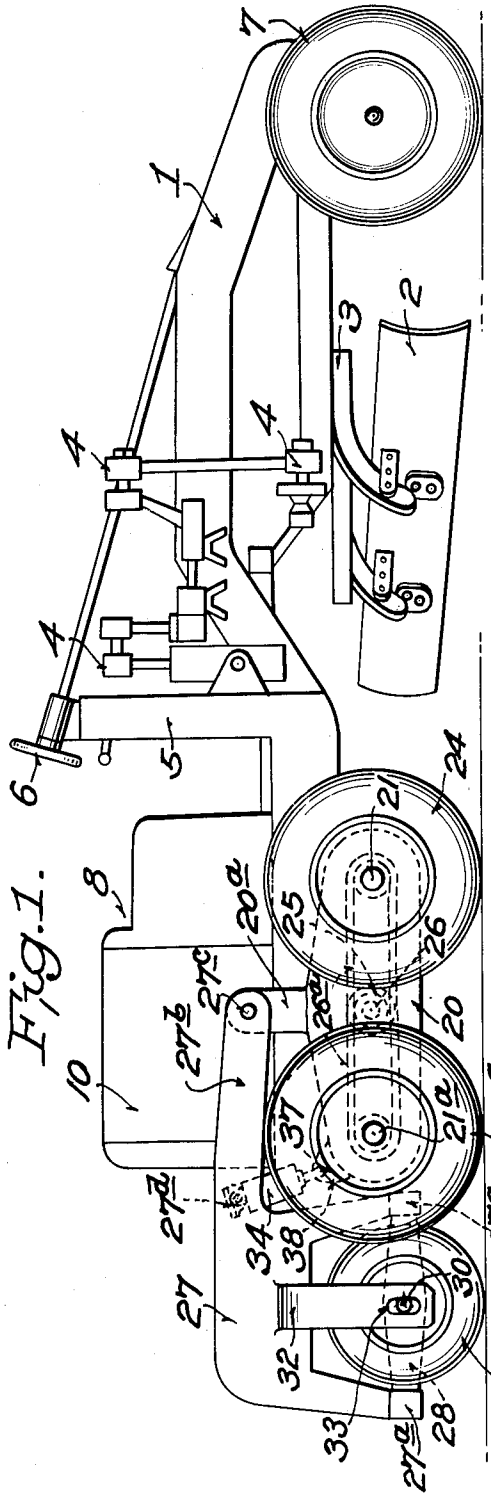


Fig. 1.

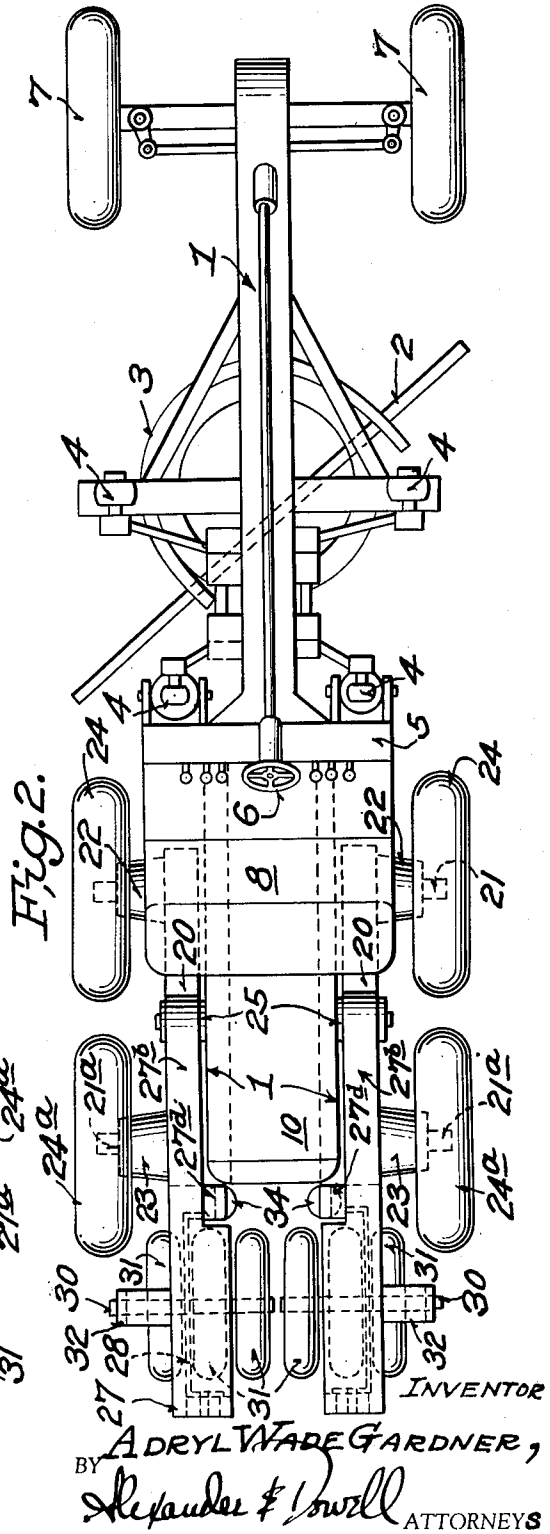


Fig. 2.

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ROLLER FOR LAND GRADING MACHINE

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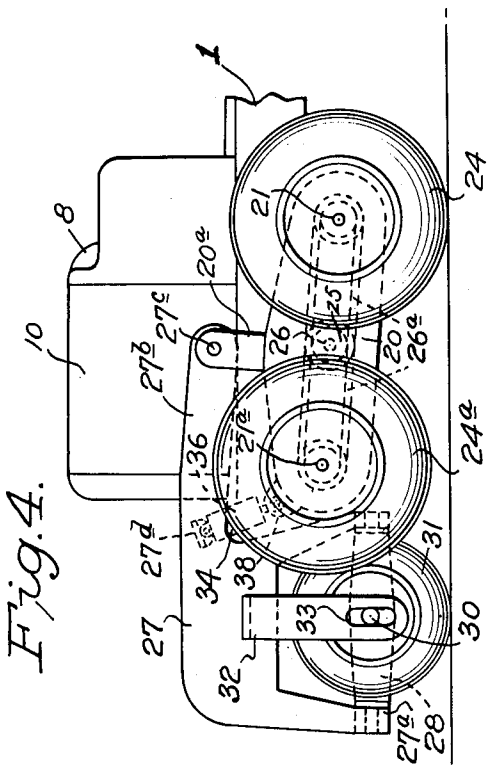


Fig. 4.

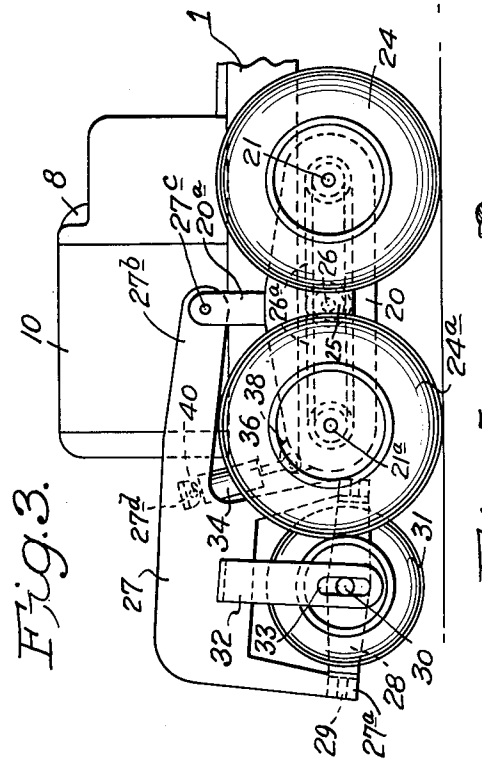


Fig. 3.

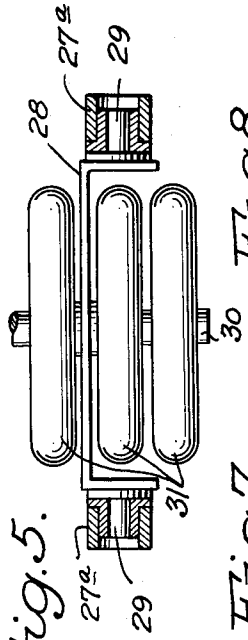


Fig. 5.

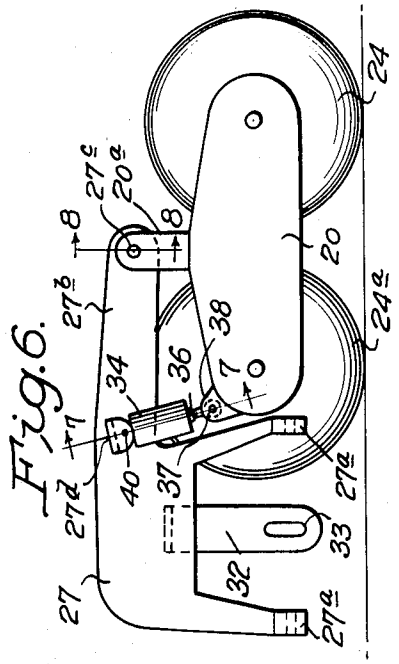


Fig. 6.

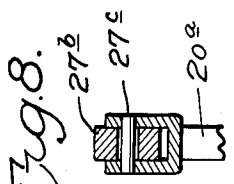


Fig. 8.

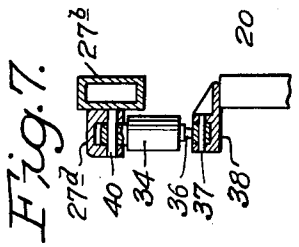


Fig. 7.

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ROLLER FOR LAND GRADING MACHINE

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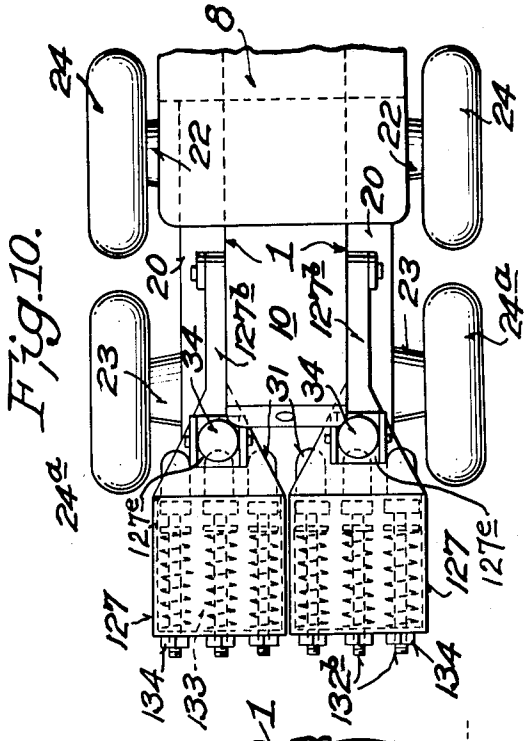


Fig. 10.

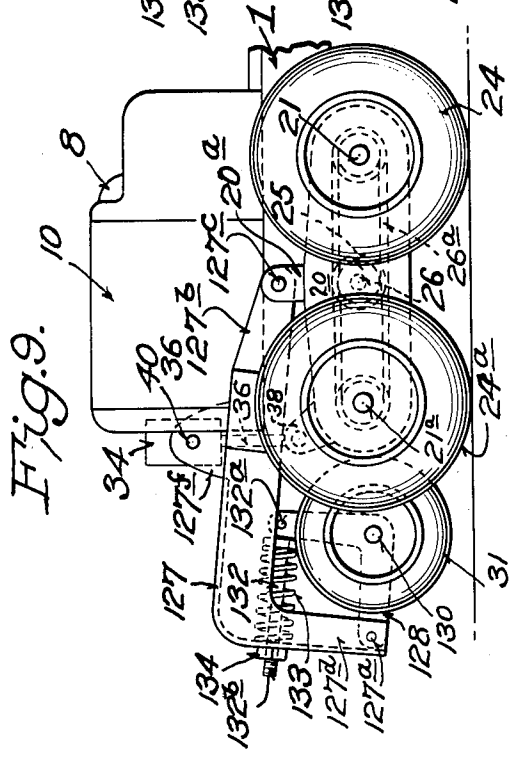


Fig. 9.

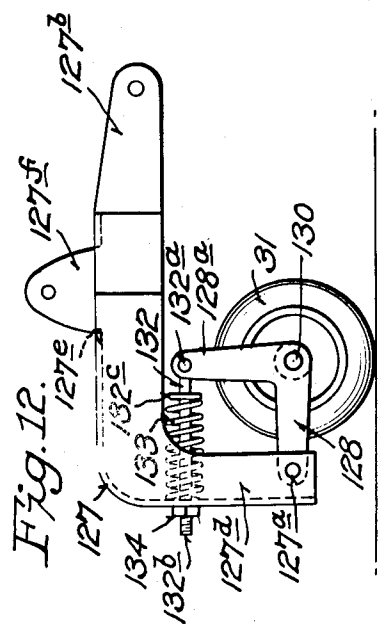


Fig. 12.

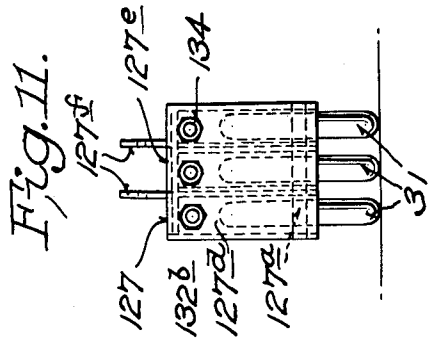


Fig. 11.

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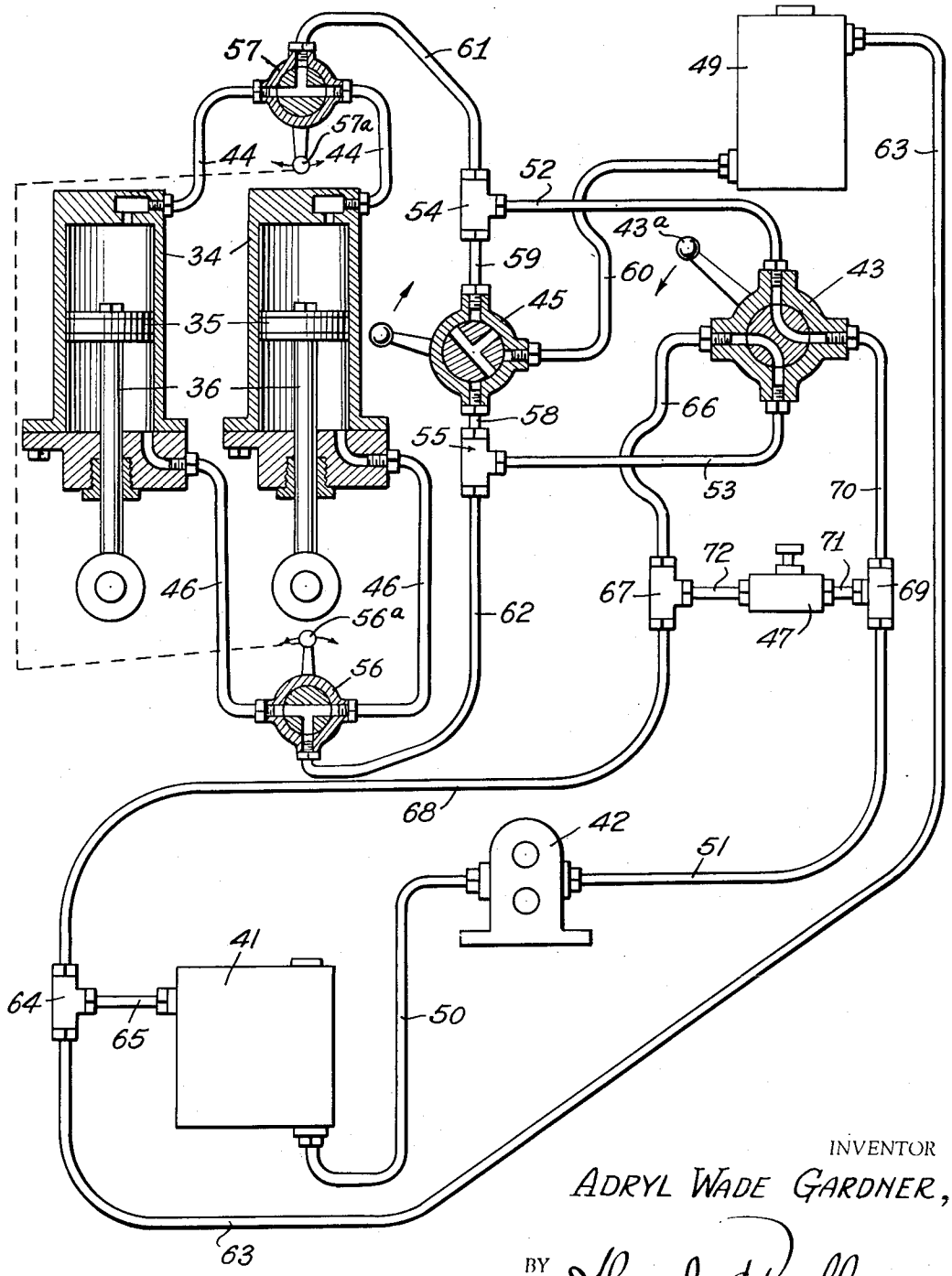
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ROLLER FOR LAND GRADING MACHINE

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Fig. 13.



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United States Patent Office 2,721,405 Patented Oct. 25, 1955

2,721,405

ROLLER FOR LAND GRADING MACHINE

Adryl Wade Gardner, Redlands, Calif.

Application January 28, 1954, Serial No. 406,712

13 Claims. (Cl. 37—146)

My invention relates to road building and maintaining machinery, and relates more particularly to road grading machines equipped with rollers for simultaneously rolling the graded surface during each pass of the scraper.

It is an important object of my invention to provide a combination road grader and roller wherein a standard road grading machine may be fitted with rolling means to provide a single machine capable of performing on each pass first a grading function and then a rolling function immediately thereafter.

In the past, road graders have been provided with rolling equipment in the form of either a towed unit, or in the form of a fixed rolling device attached to the grader chassis so that the roller may be lowered into engagement with the ground or may be elevated thereabove during periods of disuse. In the form of roller which is merely towed behind the road grader the roller carries none of the weight of the grading machine and therefore there can be no inter-relation between the weight of the grading machine which is supported by the roller and that which is supported by the grader drive wheels. In another form of rolling device which, according to the prior art has been fixed to the grader chassis, there is the inherent disadvantage that when the rolling mechanism is lowered into working contact with the ground the roller is held in fixed relation with respect to the guide and traction wheels of the grader, and thus the roller is not free to independently follow transverse and longitudinal variations in the grade surface.

Therefore, one very important object of the present invention is to provide in combination with a road grader a rolling device which compacts the grade material to a substantially uniform degree both longitudinally and transversely across the path of advance of the machine. To achieve this purpose, it is necessary that the rolling device not be rigidly mounted on the chassis of the grader, since when the rolling device is rigidly attached thereto uniform compaction of the grade material is not achieved because the roller stresses the high spots of the material heavily but scarcely touches the lower spots. Moreover, when the rolling device is rigidly attached to the chassis, an elevated spot in the grade material which cannot be leveled by the compaction effort of the roller causes the roller to lift the grader chassis at the point of attachment, and such lifting causes the normal weight distribution on the wheels of the grader to be altered so that either steering of the grader is impaired or else the grader is hung up with its drive wheels suspended off the ground. This type of machine, therefore, is unsatisfactory in that it attempts to roll the grade material to a constant level rather than to roll the material to a uniform degree of compaction.

It is therefore a primary object of my invention to provide a combined grader and roller wherein not only are the rolls so mounted that they are free to follow both the transverse and longitudinal variations in the grade surface but so that the rolls and the drive wheels can be adjusted to divide the weight of the machine according to a predetermined ratio.

In order to accomplish the purpose set forth in the last

paragraph, I have used a type of grading machine having a tendem drive frame on each side of its chassis, which tandem drive frames are respectively journaled near their longitudinal center to the chassis of the machine. Each tandem drive frame has a forward and an aft drive axle extending transversely outwardly therefrom, the drive axles being equally spaced with respect to the journal mounting of each tandem drive frame to the chassis, and each drive axle carrying a ground-engaging drive wheel. The drive from the engine of the grader to the respective drive wheels is transmitted through the journal to chain drives located within the tandem drive frames, which chain drives respectively drive the forward and aft axles and thereby drive the forward and aft ground-engaging drive wheels. The rollers are mounted on roller carrying frames, one roller frame being located behind each of the tandem drive frames, and the roller frames being pivotally connected by horizontally disposed pivot pins to the tandem drive frames near the longitudinal centers thereof.

I have also provided an hydraulic piston and cylinder means for controlling the mutual angular positions of the respective tandem drive frames and their associated roller frames, each hydraulic means being connected at one end to the aft end of a tandem drive frame and being connected at its other end to the associated roller frame at a location behind the pivotal connection of the roller frame to the tandem drive frame. It may therefore be seen, by pressurizing the hydraulic piston and cylinder means, that either the roller frame may be pivoted upwardly out of engagement with the ground so that the support of the aft end of the grader is entirely by the ground-engaging drive wheels, or else that the hydraulic means may be actuated in the opposite direction so as to raise the aft ground-engaging drive wheels out of contact with the ground so that the weight of the aft end of the grader will then be supported on the forward drive wheels and on the roller wheels located therebehind, the weight being divided therebetween in proportion to the ratios of the distances from the drive frame journals to the respective wheels and rollers.

When the aft drive wheels are raised out of engagement with the ground, the roller wheels and forward drive wheels will be free to follow longitudinal variations in the contour of the ground being rolled because the composite assembly of the tandem drive frames and the roller carrying frames will be free respectively to pivot about the journals which mount the tandem drive frames to the grader chassis.

Each roller mounting frame carries a plurality of rollers, and the rollers are secured to the frame in such a way that the proportion of the weight of the grader carried by each roller frame is distributed substantially equally among the plurality of roller wheels. These roller wheels are not rigidly mounted to the roller carrying frames, but are capable of vertical movement with respect thereto, and it is by virtue of this type of mounting of the roller wheels to the roller frames that the roller wheels are free to follow the transverse contour variations in the ground surface to be rolled.

It is a further object of this invention to provide the hydraulic control system with additional means whereby the pistons and cylinders may be depressurized so as to permit the rollers to be merely towed by the grader machine without having the rollers support the weight of the machine.

Other objects of my invention include the provision of strong and simple roller structures which will not only allow the scraping function of the machine to operate with its full efficiency but which will at the same time contact the surface of the grade material after the latter has been scraped and roll the material to a uni-

form degree of compaction, as distinguished from compaction to a level surface.

Another object of my invention is to provide roller means which may be quickly and easily detached from, or connected to, the tandem drive frames of a grader machine.

A further object of my invention is to provide means whereby the respective roller frames may be individually controlled so that one roller frame may be raised to inoperative position and maintained therein, while the other roller frame may be lowered so as to place the associated roller wheels into engagement with the ground and raise the associated aft drive wheel out of engagement therewith. This type of operation is important in that it permits the attachment on one side of the grading machine to be used as a trench roller.

Further objects and advantages of my invention will become apparent during the more detailed description of my invention.

I will now describe with particularity the embodiments of my invention shown in the accompanying drawings wherein:

Fig. 1 is a side elevation of a standard grading machine to which has been added roller carrying frames and hydraulic piston and cylinder means for controlling the relative angular relation between each tandem drive frame and the associated roller carrying frame.

Fig. 2 is a plan view of the combination grader and roller shown in Fig. 1.

Fig. 3 is a partial elevation view corresponding to Fig. 1 but showing the hydraulic piston and cylinder means pressurized so as to elevate the roller carrying frames and thereby raise the roller wheels out of contact with the ground.

Fig. 4 is a partial elevation view similar to Fig. 3 but showing the hydraulic piston and cylinder means pressurized in the opposite direction so as to place the roller wheels in contact with the ground and so as to raise the aft drive wheels out of contact with the ground, this type of operation also permitting the device to be used as a trench roller.

Fig. 5 is a detail plan view showing the mounting of a set of roller wheels to trunnion bearings in a roller carrying frame.

Fig. 6 is a detailed elevation view showing a roller carrying frame mounted to a tandem drive frame and showing one manner of mounting the hydraulic piston and cylinder means therebetween.

Fig. 7 is a sectional view along line 7—7, Fig. 6.

Fig. 8 is an enlarged sectional view along line 8—8, Fig. 6.

Fig. 9 is an elevational view corresponding to Fig. 3 but showing a modified form of roller carrying frame and roller supporting means attached to a tandem drive frame.

Fig. 10 is a plan view of the modification shown in Fig. 9.

Fig. 11 is an aft elevation view of the modified form of roller carrying frame, rollers and roller supporting means, disconnected from the grading machine.

Fig. 12 is a side elevation view corresponding to Fig. 11.

Fig. 13 is a schematic diagram showing the hydraulic system used to control the relative angular positions of the tandem drive frames and the roller supporting frames.

Referring to the drawings, the particular grader-roller shown therein includes the elements of a standard road grader, consisting principally of a main chassis which may be of any suitable construction and is designed **1** in its entirety. The machine further includes a conventional grader blade **2**, a standard A-frame and circle assembly **3**, and a standard blade lifting mechanism **4** by means of which the elevation of the grading blade **2** is controlled. A conventional instrument and control pedestal **5** supports a steering wheel **6** which controls steerable front wheels **7** on which the front end of the chassis **1** rests. An operator's seat **8** is located on chassis **1** adjacent control pedestal **5**.

Further elements of the standard form of road grader include an engine and engine housing **10**, and a pair of tandem drive frames **20**. Tandem drive frames **20** are a part of the standard form of road grader shown and are provided with traction wheel drive axles **21** and **21***a*, respectively, journaled in carriers **22** and **23**.

As shown in Figs. 1 and 2, the drive axles **21** which are journaled in the forward carriers **22** are provided with ground engaging drive wheels **24**, and drive axles **21***a* which are journaled in aft carriers **23** are provided with aft ground engaging drive wheels **24***a*.

In the standard form of road grader shown in the drawings, the chassis **1** is supported at the rear on journals **25** on which the tandem drive frames **20** are pivotally mounted. Concentric with and journaled in journals **25** are the transmission drive shafts **26** which are connected through chain drives **26***a* to transmit power from the engine **10** and main transmission to the drive axles **21** and **21***a*.

The description of the machine thus far has been directed toward only the essential elements of a standard road grader.

The rolling means according to my invention are connected to the respective tandem drive frames at the brackets **20***a*, which brackets extend upwardly from the tandem drive frames **20** to which they are rigidly secured. The particular embodiment of the rolling means shown in Figs. 1, 2, 3, 4, 5 and 6 includes two separate roller frames **27**, each of which frames has a forwardly extending portion **27***b* adapted to be pivotally secured to the upper end of each bracket **20***a* by pins **27***c*. The roller frames **27** are each fitted with a pair of aligned trunnion bearings **27***a* in which are journaled trunnion beams **28**, a plan view of which is shown in Fig. 5. Aligned trunnion pins **29** are journaled in trunnion bearings **27***a* to permit oscillation of trunnion beams **28**. Projecting laterally from the trunnion beams **28** are roller wheel axles **30** on which are journaled a plurality of roller wheels **31**. Oscillation of the trunnion beams **28** around the trunnion bearings **27***a* permits the roller wheels **31** to follow the transverse ground contours, and the angle through which the beams **28** may oscillate is limited by the frame members **32** which are provided with vertically disposed slots **33** in which the ends of the axles **30** are confined. In addition, each of the roller carrying frames **27** is provided with a bracket **27***d* for the purpose hereinafter stated.

In the drawings, Figs. 9, 10, 11 and 12, I have shown a modified form of the roller means, which modified form is attached to the grading machine at the tandem drive frames **20** in the same manner as set forth with respect to the previously discussed form of roller means. In the present modification the roller means includes a roller carrying frame **127** having a forwardly extending portion **127***b* adapted to be pivotally secured to the bracket **20***a* upon each tandem drive frame **20** by a pin **127***c*. Through the rear portion **127***d* extends a transverse pivot rod **127***a*, which rod has journaled thereon a plurality of roller supporting arms **128**. Each of the arms **128** has journaled thereon a roller wheel **31** supported on the arm by a stub axle **130**. It will also be noted that each roller supporting arm **128** has an upwardly extending portion **128***a* in the top of which is pivotally mounted a spring supporting rod **132** attached to the portion of the arm **128***a* by a pin **132***a*. The rod **132** extends rearwardly through the portion **127***d* of the roller supporting frame **127**, the rod **132** being terminated at its aft end with a threaded portion **132***b*. A compression spring **133** is supported on each rod **132** between the aft end of the frame **127***d* and a spring seat **132***c* secured to the rod **132**. By reference to Figs. 10 and 11 it will be seen that each roller supporting

frame 127 carries a plurality of independently mounted roller wheels 31, which wheels are capable of moving vertically up and down as they roll over the ground, the vertical motion being opposed only by the force of each coil spring 133. In order to control the amount of pressure imposed by each spring 133, the threaded aft end of each rod 132*b* is provided with a nut 134 whereby the minimum compression of the spring 133 may be initially adjusted. Each roller supporting frame 127 is further provided with an opening 127*e* which is located between a pair of upstanding brackets 127*f*, which brackets serve the purpose hereinafter explained.

As stated in the objects of this invention, I have provided hydraulic control apparatus for determining the relative angular positions of the tandem drive frames 20 with respect to the roller frames 27 (or 127). This hydraulic apparatus includes a pair of hydraulic cylinders 34 pivotally mounted as at 40 at their upper ends to brackets 27*d* carried by the roller frames 27 (or to brackets 127*f* carried by the modified form of roller frame 127). The cylinders 34 are equipped with reciprocable pistons 35 having piston rods 36 pivotally connected as at 37 to brackets 38 fixed to tandem drive frames 20 (Figs. 6, 7 and 9).

Further elements of the hydraulic circuit, shown in Fig. 13, include a sump 41 for oil, or other fluid, the oil flowing by suction through a pipe 50 to a pump 42. 51 denotes the outlet pipe leading from said pump, said pipe communicating through a T 69 and a pipe 70 with valve casing 43. Valve casing 43 communicates with a T 54 through pipe 52 and then through a pipe 61 to another valve 57, thence through pipes 44 into the upper ends of the cylinders 34.

The valve casing 43 also communicates through a pipe 53 to a T 55 and through a pipe 62 to another valve 56, thence through pipes 46 to the lower ends of the cylinders 34. T's 54 and 55 also communicate respectively through pipes 59 and 58 respectively with another valve casing 45, said valve 45 being connected through a pipe 60 to an elevated expansion tank 49, which is returned to the sump 41 through pipe 63, T 64 and pipe 65. Valve casing 43 is returned to the sump 41 through pipe 66, T 67, pipe 68, T 64 and pipe 65. T 69 communicates with T 67 through pipe 71, pressure relief by-pass valve 47, and pipe 72.

With the parts of the hydraulic circuit arranged as described, the manner in which the hydraulic controls operate can be readily understood. With the hydraulic circuit filled with oil or other operating fluid, and with the valves set as shown in Fig. 13, operating fluid is supplied under pressure against the upper sides of pistons 35 in cylinders 34, causing pistons 35 and rods 36 to travel downwardly. Fluid displaced from the lower ends of cylinders 34 by pistons 35 is discharged through pipes 46, 62, 53, valve 43, pipes 66, 68 and 65 to sump 41. When valve 43 is rotated by control lever 43*a* through an angle of 90° counter-clockwise fluid under pressure is supplied against the lower sides of pistons 35 in cylinders 34, causing pistons 35 and rods 36 to travel upwardly. Fluid displaced from the upper ends of cylinders 34 by pistons 35 is discharged through pipes 44, 61, 52, valve 43, pipes 66, 68 and 65 to sump 41. When valve 43 is rotated to an intermediate or closed position, pistons 35 and rods 36 are held against movement in either direction. Under such a condition, fluid delivered under pressure from the pump flows through pipes 51 and 71 through pressure relief by-pass valve 47 and is returned through lines 72, 68 and 65 to sump 41. It can thus be seen that pistons 35 and rods 36 can be forced to move in either direction and can also be held against movement, by selectively setting valve 43.

It will also be seen that forced movement of the pistons 35 and rods 36 will cause a change in the relative angular position between the roller mounting frames 27 (or 127) and the tandem drive frames 20 so that by pressurizing the hydraulic cylinders 34 in such a direction as to cause the piston rods 36 to extend outwardly therefrom, the roller supporting frames 27 (or 127) will be elevated so as to raise the rollers 31 off the ground as shown in Fig. 3 or Fig. 9. Furthermore, by pressurizing the cylinders 34 in such a direction as to cause the piston rods 36 to be fully retracted into the cylinders 34, it will be seen in Fig. 4 that the aft ground engaging drive wheels 24*a* will be elevated off the ground, Fig. 4, so that the weight of the grading machine as applied to the tandem drive frames 20 at the journals 26 will be distributed between the roller wheels 31 and the forward ground engaging drive wheels 24 in proportion to the relative distances between the journals 26 and the axles 30 and axles 21. The important advantage of this structure is that no matter what the ground contour may be at any particular location the forward traction wheels 24 at all times remain in full contact with the ground and at all times support their proportion of the weight of the grader machine as applied to the journals 26. It should further be apparent that by setting the valve 45 in open position the hydraulic cylinders 34 will then be equalized so that the pressure above the pistons 35 is exactly the same as the pressure below the pistons 35, at which time the weight of the grading machine will be supported only by the drive wheels 24 and 24*a*. In this manner of operation the roller supporting frames 27 (or 127) are merely towed behind the machine and do not carry any of the weight thereof.

Valves 56 and 57 in the hydraulic circuit shown in Fig. 13 are provided for the purpose of permitting the respective roller frames to be separately controlled so that, as stated in the objects of this invention, the combined grading and rolling machine may be used as a trench roller. With valves 56 and 57 set in the position shown in Fig. 13, both cylinders are connected in parallel for unitary operation. However, if the control levers 56*a* and 57*a* are each moved 90° to the right in Fig. 13, the right piston 35 will be locked in its then-existing position and the valves 43 and 45 will then control only the left piston 35. Conversely, if the valve control levers 56*a* and 57*a* are moved 90° to leftward from the position shown in Fig. 13, the left piston 35 will be locked and only the right piston 35 will then be controlled by the valves 43 and 45. With this arrangement it may be seen that either roller frame may be placed in operative position, Fig. 4, while the opposite roller frame is maintained in inoperative position, Fig. 3.

Other apparatus for controlling the relative positions of the tandem drive frames 20 and the roller frames 27 may be employed. The hydraulic means herein described is shown only as an example of means for providing the desired control action.

I do not limit my invention to the particular forms shown in the drawings, for obviously changes may be made within the scope of the claims.

I claim:

1. In combination with a road material grading machine having a chassis supported at one end on ground-engaging steerable wheels, and having on each side of the other end of the chassis a longitudinally disposed drive frame, each drive frame being journaled near its center to said chassis on an axis transverse thereof, and having on each drive frame a pair of power-driven ground-engaging drive wheels, the drive wheels of each pair being located respectively forward and aft with respect to said transverse axis; compaction means comprising a pair of roller frames, each pivotally connected at one end to a drive frame; ground-engaging rollers journaled on each roller frame; and power actuated means connected between each drive frame and its associated roller frame whereby when said means is energized in one direction said roller and drive frames will be articulated in a direction to raise the drive wheels adjacent the roller frame off the ground, and when said means is energized in the other direction

said roller and drive frames will be articulated in a direction to raise the rollers off the ground, the combined transverse width of the rollers being at least sufficient to cover the ground between the drive wheels on each side of the machine.

2. In a device as set forth in claim 1, said rollers being journaled on stub axles; and connecting means between said stub axles and said roller frames, the support of the axles on the frames by said connecting means being yieldable in the vertical direction to permit the various rollers to assume positions most nearly corresponding to the contour of the ground being rolled.

3. In combination with a road material grading machine having a chassis supported at one end on ground-engaging steerable wheels, and having at the other end of the chassis transversely disposed oppositely extending drive shafts; compaction and drive means comprising a roller frame and a drive frame on each side of said chassis, said roller frames and associated drive frames being aligned longitudinally of said chassis and each pair being respectively joined together along a horizontal axis of articulation, the drive frame in each pair being journaled intermediate its ends to the chassis on one of said drive shafts; a forward and an aft ground-engaging drive wheel on each drive frame, the respective drive wheels being located on opposite sides of said drive shaft; ground-engaging rollers journaled on each roller frame; and power actuated means connected between the drive frame and the roller frame of each pair for forcing the respective frames to articulate about said horizontal axis.

4. In a device as set forth in claim 3, said rollers being journaled on stub axles; and connecting means between said stub axles and said roller frames, the support of the axles on the frames by said connecting means being yieldable in the vertical direction to permit the various rollers to assume positions most nearly corresponding to the contour of the ground being rolled.

5. In a device as set forth in claim 3, control means associated with said power-actuated means whereby the associated drive and roller frames on one side of said chassis may be articulated in the opposite direction from the associated drive and roller frames on the other side of said chassis.

6. A combined road material scraper and roller comprising a chassis; ground-engaging steerable wheels supporting one end of said chassis; a drive frame and a roller frame on each side of said chassis near the other end thereof, the frames of each pair being aligned longitudinally of the chassis and being pivotally joined along a horizontal axis of articulation; an engine on said chassis; a drive shaft extending transversely outwardly from said chassis on each side thereof, the respective drive frames being journaled intermediate their ends on said drive shafts; a forward and an aft drive wheel carried by each drive frame and disposed on opposite sides of said drive shaft and rotationally connected therewith; ground-engaging rollers journaled on said roller frames; and power-actuated means connected between the pairs of frames for forcibly articulating the latter about said horizontal axis.

7. In a device as set forth in claim 6, said rollers being journaled on stub axles; and connecting means between said stub axles and said roller frames, the support of the axles on the frames by said connecting means being yieldable in the vertical direction to permit the various rollers to assume positions most nearly corresponding to the contour of the ground being rolled.

8. In a device as set forth in claim 6, control means associated with said power-actuated means whereby the associated drive and roller frames on one side of said chassis may be articulated in the opposite direction from the associated drive and roller frames on the other side of said chassis.

9. An attachment for use on a road material grading machine having a chassis supported at one end on ground-engaging steerable wheels, and having on each side of the other end of the chassis a longitudinally disposed drive frame, each drive frame being journaled near its center to said chassis on an axis transverse thereof, and having on each drive frame a pair of power-driven ground-engaging drive wheels, the drive wheels of each pair being located respectively forward and aft with respect to said transverse axis; comprising a pair of roller frames, each pivotally connected at its forward end to a drive frame; ground-engaging rollers journaled on each roller frame; and power actuated means connected between each drive frame and its associated roller frame whereby when said means is energized in one direction said roller and drive frames will be articulated in a direction to raise the aft drive wheels off the ground, and when said means is energized in the other direction said roller and drive frames will be articulated in a direction to raise the rollers off the ground.

10. In a device as set forth in claim 9, said rollers being journaled on stub axles; and connecting means between said stub axles and said roller frames, the support of the axles on the frames by said connecting means being yieldable in the vertical direction to permit the various rollers to assume positions most nearly corresponding to the contour of the ground being rolled.

11. In a device as set forth in claim 9, control means associated with said power-actuated means whereby the associated drive and roller frames on one side of said chassis may be articulated in the opposite direction from the associated drive and roller frames on the other side of said chassis.

12. In combination with a land vehicle having a chassis supported at one end on ground-engaging steerable wheels, support and drive means for the other end of said chassis comprising, a drive frame journaled near its center on each side of said chassis, each drive frame having a forward and an aft ground-engaging drive wheel; a roller frame connected to each drive frame by a pivot disposed transversely of said chassis, each roller frame carrying a plurality of ground-engaging rollers; power actuated means connected between each drive frame and its associated roller frame to forcibly articulate said frames about said pivots; and control means associated with said power actuated means whereby the respective frames on each side of the chassis may be selectively articulated in the same direction or may be articulated in mutually opposite directions.

13. In a land vehicle having a chassis and having ground-engaging wheels supporting one end of the chassis, support and drive means for the other end of said chassis, comprising a first frame means disposed longitudinally of the chassis and pivotally connected therewith along a transverse axis; a forward pair and an aft pair of power-driven drive wheels journaled on said first frame means, the wheels of the respective pairs being spaced transversely of the vehicle and the respective pairs of wheels being located on longitudinally opposite sides of said transverse axis; a second frame means adjacent said first frame means and pivotally connected therewith transversely of the vehicle; ground-engaging rollers carried by said second frame means; and power-actuated means connected between said first and second frame means for forcing the respective frame means to articulate with respect to each other.

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