April 15, 1941. H. SORENSEN 2,238,346

APPARATUS FOR TILTING BULLDOZER BLADES

Filed Oct. 4, 1940 4 Sheets-Sheet 1

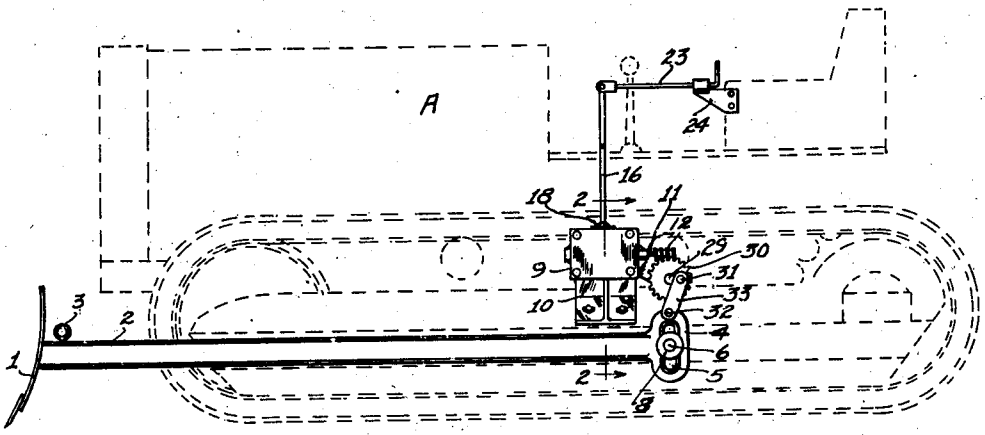


Fig. 1

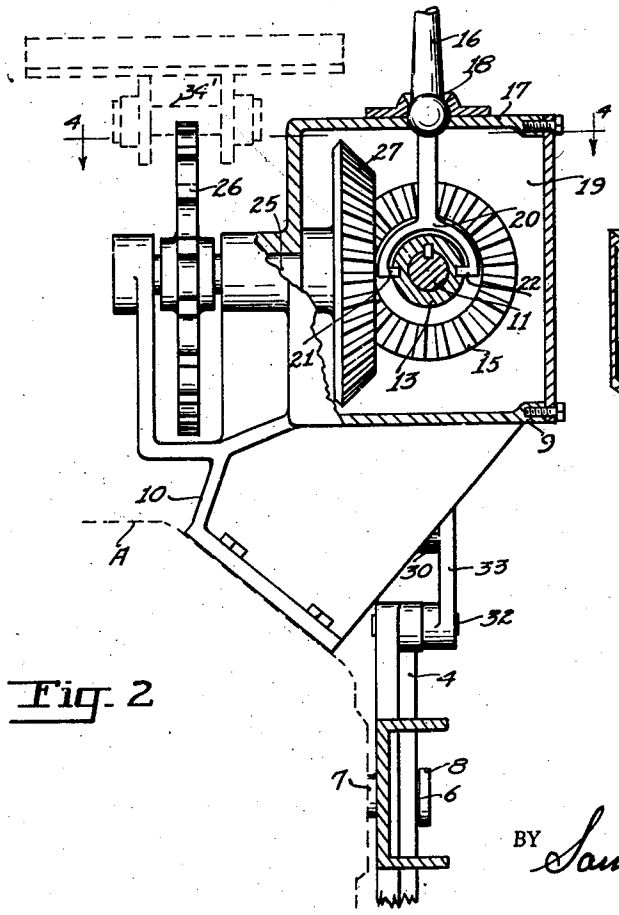


Fig. 2

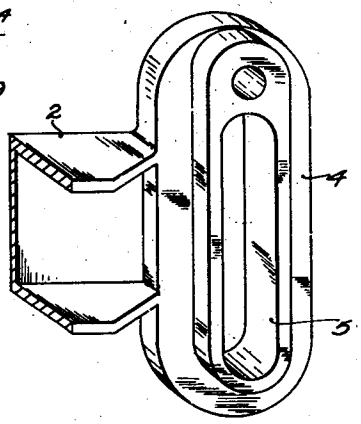


Fig. 3

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APPARATUS FOR TILTING BULLDOZER BLADES

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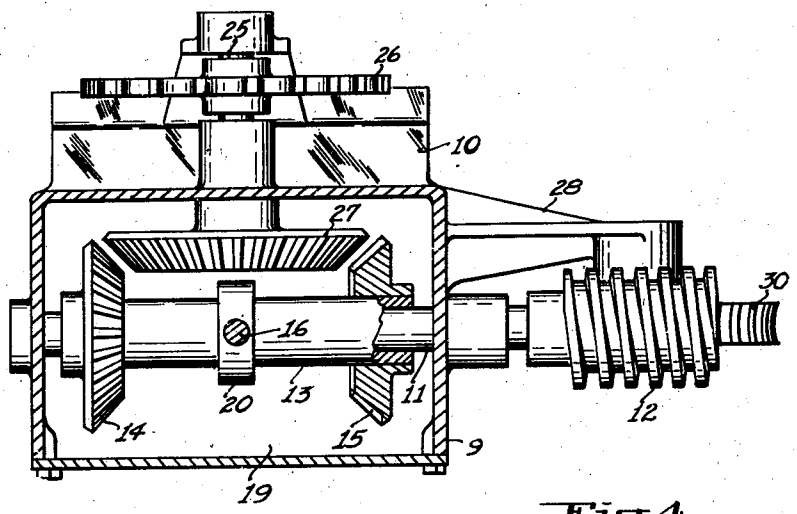


Fig. 4

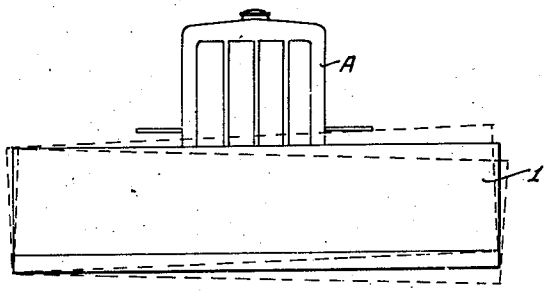


Fig. 5

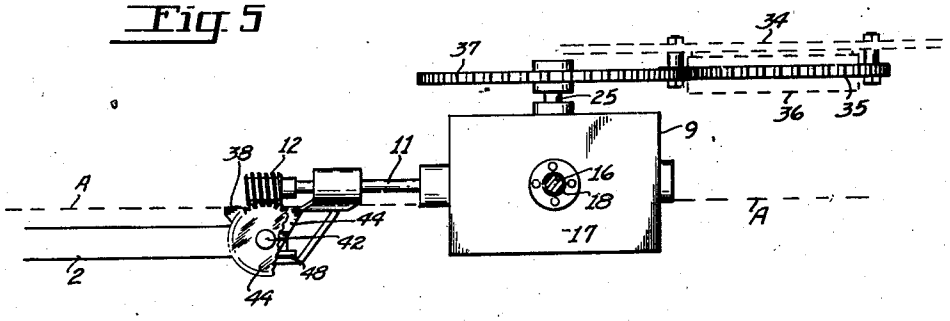


Fig. 7

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APPARATUS FOR TILTING BULLDOZER BLADES

Filed Oct. 4, 1940 4 Sheets-Sheet 3

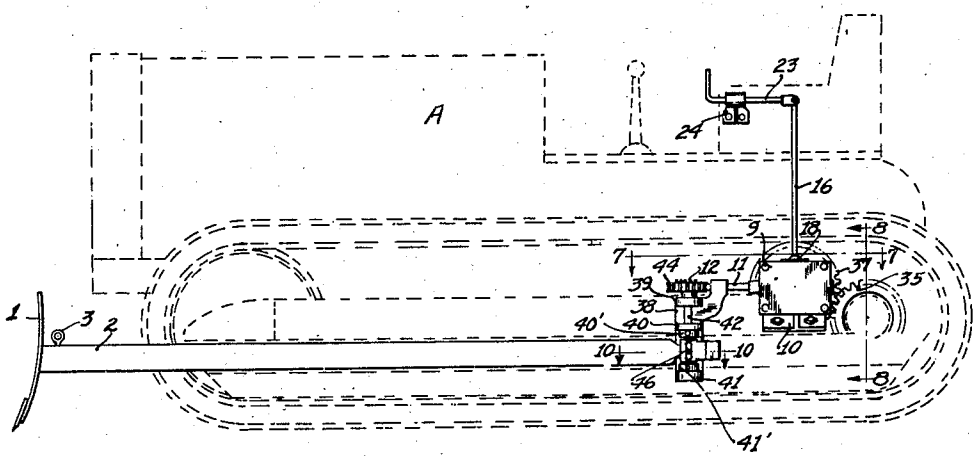


Fig. 6

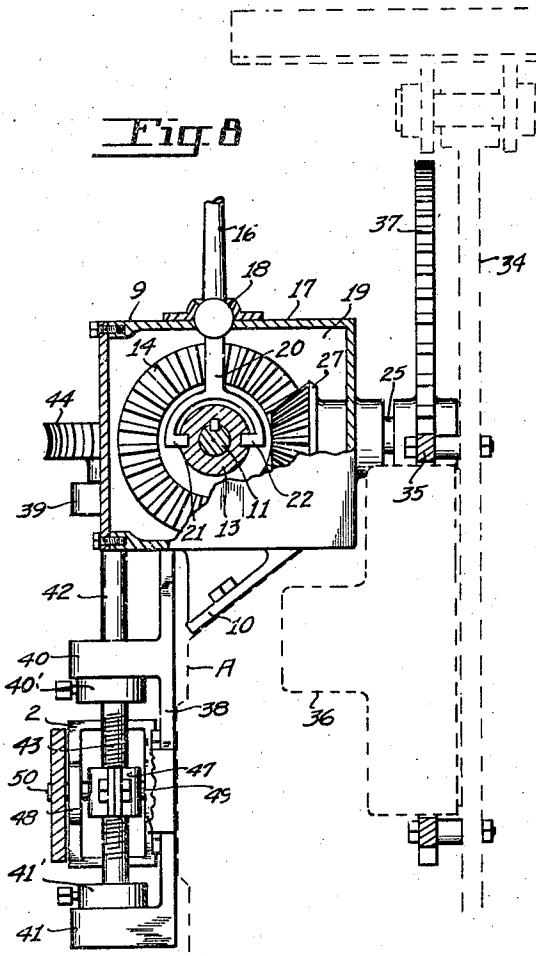
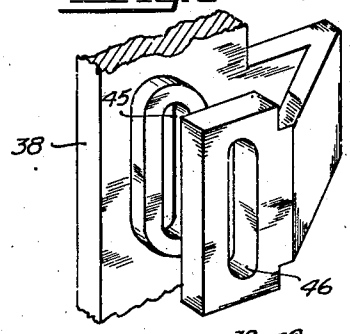


Fig. 8

Fig. 9



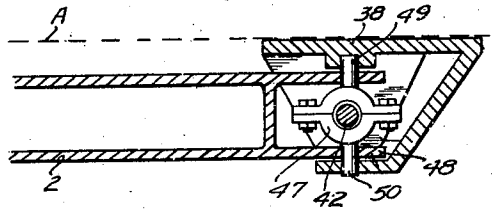


Fig. 10

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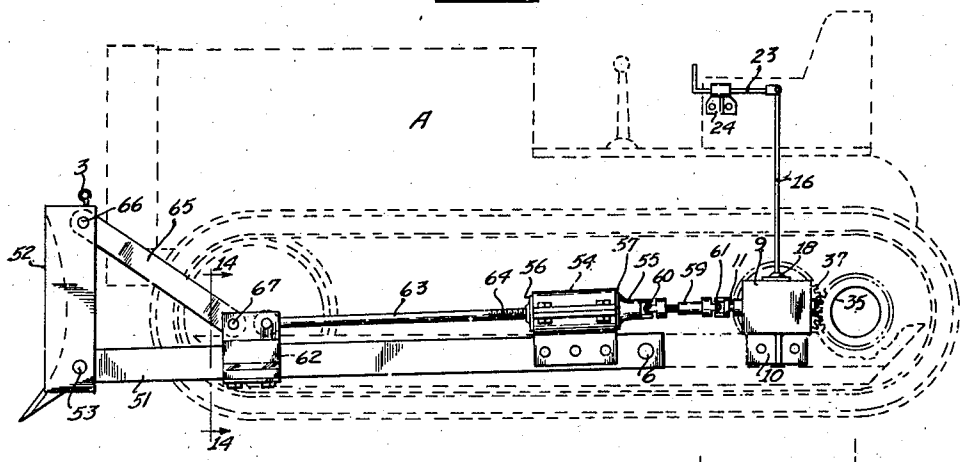
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April 15, 1941. H. SORENSEN 2,238,346

APPARATUS FOR TILTING BULLDOZER BLADES

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Fig. 11



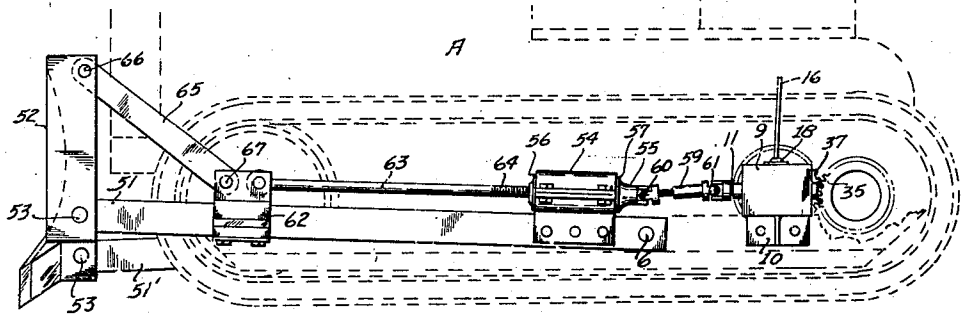


Fig. 12

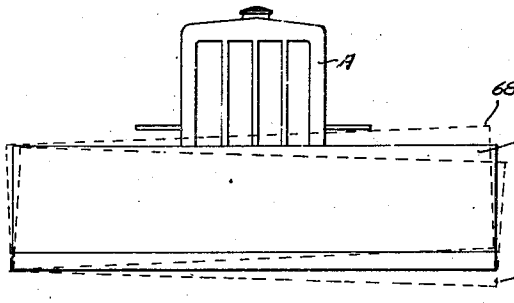


Fig. 13

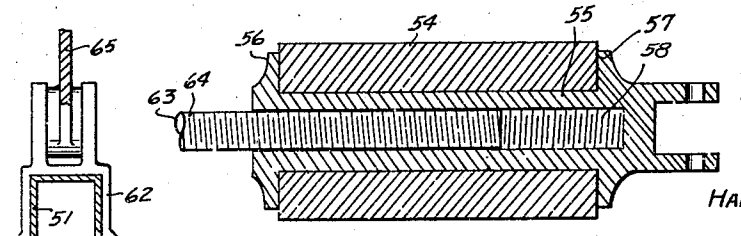


Fig. 14

Fig. 15

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Patented Apr. 15, 1941 2,238,346

UNITED STATES PATENT OFFICE

2,238,346

APPARATUS FOR TILTING BULLDOZER BLADES

Harold Sorensen, Knappa, Oreg.

Application October 4, 1940, Serial No. 359,652

25 Claims. (Cl. 37—144)

My invention, defined broadly, relates to a scraper or bulldozer blade and its related structure; and, when defined specifically, the invention relates to a scraper or bulldozer blade and related structure secured to a tractor and operatively associated with apparatus for tilting the blade, whenever desired, during the movement of the tractor employed for building roads.

It is now common practice to provide some means on bulldozers for varying the vertical angle as well as the arc presented by a scraper or bulldozer blade to the surface being worked. This is necessary because not the least of the problems of road and trail building is to overcome the difficulties presented by terrain which possesses uneven topographical features, varying geologic formations and varying composition and texture. Furthermore, in many instances in building roads and trails, it is necessary to cut and gouge the road or trail grade on the side of a hill and the bulldozer-carrying vehicle must necessarily assume the same angle as the hill until the grade is sufficiently cut into the side of the hill to make a roadway large enough for the vehicle to travel thereon. It is evident, therefore, that unless some means are provided to allow the scraper or bulldozer blade to assume an angle different from the angle of repose of the hillside, the cutting and gouging of a grade through a hillside by a tractor and bulldozer assembly would be extremely difficult, if not impractical. It must also be pointed out that road grading requires crowning of the grade and ditching on each side thereof.

It is within the contemplation and the very essence of the invention to provide improved means for raising or lowering one side of the frame and thereby to tilt and vary the angle of the scraper or bulldozer blade from its normal horizontal position so that the pressure on the blade will be varied accordingly and thus cause one or the other end of the blade to do a proportionately greater amount of the work by cutting at a proportionately greater angle to the horizontal.

One of the important objects of this invention is to provide manually operated means for permitting the blade to assume an angle different from the angle assumed by the vehicle to which the bulldozer assembly is secured.

Another object of this invention is to provide means for varying the angle of the blade from its normal horizontal position in order to permit the operator of a tractor and bulldozer assembly, when building roads or trails, and grading the same, to compensate for any differences in the contour, composition, and geologic formation of the ground through which a road or trail is being built and to create a greater "crowding" force on certain portions of the blade in order to compensate for these varying factors.

Another object of the invention is to provide blade-tilting means which receives its power from the vehicle to which the bulldozer assembly is attached.

A very important object of the invention is to provide means for raising and lowering one side of the blade while the vehicle to which the bulldozer assembly is attached is traveling and without the necessity of the operator's leaving his working position, thereby materially reducing the amount of time and effort presently required to adjust the position and angle of the blade.

Still another object of the invention and one of substantial importance is to provide means for permitting the operator of a tractor to which the bulldozer assembly is attached for changing the position of the blade so that the degree of bite of the blade and the amount of work to be performed by the blade may be varied to meet the needs at hand.

Another object of the invention is to provide means to permit the operator of the vehicle to which the bulldozer assembly is attached to regulate the amount of work to be performed by various portions of the blade during road building operations and to obtain the greatest cutting efficiency from the blade and with a lesser amount of effort, time and expense.

A full and complete understanding of the invention and its objects and advantages may be obtained from a consideration of the following detailed description which, for clarity, must be read in connection with the disclosures in the accompanying drawings forming a part of this specification and depicting several embodiments of the invention and in which:

Figure 1 is a side view of the apparatus embodying the principles of my invention, showing its position relative to a tractor indicated in dotted lines;

Figure 2 is an end view taken on line 2—2 of Figure 1 looking in the direction indicated, partly in section and partly broken away, disclosing the structural features of the power take-off, power transmitting means, and that part of the blade-supporting frame which embodies the principles of my invention;

Figure 3 is a perspective view of a fragment of the side beam of the blade-supporting frame, showing the structural characteristics of the rear end of the side beam;

Figure 4 is a sectional, plan view, partly taken on line 4—4 of Figure 2 looking in the direction indicated, showing the details of the power take-off and power transmitting mechanism;

Figure 5 is a front elevation, diagrammatically shown, of a scraper or bulldozer blade whose position relative to the tractor is controlled by the tilting means embodying my invention, illustrating, in dotted lines, the maximum degrees of tilt from the normal position of the blade and, in full lines, the normal position of the blade;

Figure 6 is a side view of the apparatus embodying the principles of my invention, showing its position relative to a tractor indicated in dotted line and having slightly modified structural features;

Figure 7 is a top view, taken on line 7—7 of Figure 6 looking in the direction indicated, of the apparatus embodying the principles of my invention.

Figure 8 is an end view, partly in section and partly broken away, taken on line 8—8 of Figure 6 looking in the direction indicated, showing additional details of construction of the apparatus embodying the principles of my invention;

Figure 9 is a perspective front view of a fragmentary portion of the supporting member for the side beam and related structure embodying the invention shown in Figures 6 to 10 inclusive;

Figure 10 is a fragmentary section, taken on line 10—10 of Figure 6, looking in the direction indicated, disclosing additional details of construction of the apparatus embodying the principles of my invention;

Figure 11 is a side elevation of apparatus disclosing another modified embodiment of the principles of my invention, showing the blade in normal horizontal position;

Figure 12 is a side elevation of the apparatus shown in Figure 11, showing the blade in raised position;

Figure 13 is a front elevation, diagrammatically shown, of a scraper or bulldozer blade, the position of which is controlled by the tilting means shown in Figures 11 and 12 and illustrating, in dotted lines, the maximum degrees of tilt from the normal position of the blade;

Figure 14 is a fragmentary section, taken on line 14—14 of Figure 11 looking in the direction indicated, disclosing some structural details of the modified embodiment of my invention; and

Figure 15 is a sectional, side view of the bearing assembly employed in the apparatus disclosed in Figures 11 to 13 inclusive, showing its structural characteristics.

In the following detailed description of the invention the same reference characters will serve to identify corresponding and like parts in the several views of the accompanying drawings.

This application is a continuation in part of my pending United States application for the improvements in "Bulldozer tilting devices for self track-laying tractors," filed April 4, 1940, Serial Number 327,922. A scraper or bulldozer blade of the type disclosed in my United States Patent No. 2,230,704, for the improvements in "Bulldozer construction," issued February 4, 1941, although not illustrated in the drawings which are a part of the present application, may be substituted for the blade shown therein without in any way impairing the effectiveness of the invention.

Figures 1 to 4 inclusive illustrate the preferred embodiment of my invention and in Figure 1 is shown, in dotted line, a tractor of conventional design, designated generally, for purposes of this description, by reference character A. This tractor, as shown, should be considered as representative of all those types of vehicles with which my invention may be joined. A scraper or bulldozer blade 1, either of conventional design or possessing the characteristics of the scraper or bulldozer blade shown in the above cited patent, is positioned in front of the tractor and is supported by and secured to a frame of conventional design or possessing the structural characteristics of the frame disclosed in said patent. However, only the side beam 2 of the blade-supporting frame is shown, since it is the only part which is structurally altered in order to practice the invention. An eye 3 may have a cable (not shown) secured thereto for the purpose of placing the frame and the blade out of contact with the ground and to allow the tractor to be used for other purposes. The side beam 2 has a vertically slotted end-portion 4 (the structural characteristics of which may best be seen from an examination of Figure 3), which may be secured thereto in any appropriate manner or made an integral part thereof. Confined within the slot 5 of the end-portion 4 is the stub shaft or frame-supporting pin 6 which itself is rigidly secured in any manner to the track frame of the tractor A, as best shown in Figure 2 at 7. An appropriate removable guard 8 is secured to the stub shaft or pin 6 in order to securely hold the side beam on the stub shaft or pin. The width of the slot 5 is slightly greater than the diameter of the stub shaft 6 so that the side beam 2 may have some lateral movement.

A casing 9 is secured to the track frame of the tractor A by means of an appropriately shaped bracket 10 which is held in fixed relation to the track frame by well-known anchoring means. A splined shaft 11 is appropriately journaled within casing 9 and extends outwardly from one end of the casing, as best shown in Figure 4. A worm gear 12 is conventionally secured to that part of shaft 11 which extends outside of the casing 9. A sleeve 13 is slidably keyed to that part of shaft 11 which is confined within the casing 9. A beveled pinion 14 is secured to one end of the sleeve 13 and another beveled pinion 15 is secured to the other end of the sleeve 13. These pinions are identical in all respects but have their beveled portions facing each other. A gear shift control lever 16 is swivelly connected to the top 17 of casing 9 by means of a ball and socket joint, as shown at 18. The control lever extends upwardly from and also into the interior 19 of the casing and has its end 20 bifurcated to form fingers 21 and 22 that are secured in any desirable fashion to the sleeve 13. The portion of control lever 16 which extends above the top 17 of casing 9 is itself joined to link 23. A bracket 24 secured to the seat of the tractor A supports the link 23. By this arrangement the operator of the tractor has easy access to the control lever and can manipulate the position of the sleeve 13 relative to the splined shaft 11 without expending a great deal of effort or time.

An examination of Figures 2 and 4 will disclose another shaft 25 which is appropriately journaled to and positioned centrally of and extends to a limited degree into the interior 19 of casing

9. Shaft 25 lies in the same plane as shaft 11 but is positioned at right angles to shaft 11. A sprocket 26 is secured to the shaft 25 and a beveled gear 27 is secured to that portion of the shaft 25 which is confined within the interior of casing 9. The diameter of the beveled gear 27 is substantially larger than the diameter of either of the beveled pinions 14 and 15 but not large enough to contact either of the beveled pinions, when the sleeve 13 is positioned equidistant from the sides of the casing 9. Thus it becomes evident that in order to permit either one of the beveled pinions 14 and 15 to contact and mesh with the beveled gear 27, it is necessary to slide the sleeve 13 on shaft 11 and that under no condition is it possible to have both of the beveled pinions coact and mesh with the beveled gear 27. A bracket 28 extends from the casing 9 and has a stub shaft 29 extending therefrom. A worm wheel 30 is rotatably disposed on stub shaft 29 and at all times coacts and meshes with the worm 12. A wrist pin 31 extends outwardly from the worm wheel 30 and a like wrist pin 32 extends outwardly from the upper portion of the vertically slotted portion 4 of side beam 2. A connecting rod 33 is secured to the wrist pins 31 and 32.

Sprocket 26 is directly aligned and at all times contacts the track pins 34', one of which is shown in dotted line in Figure 2 for purposes of description and illustration, so that when the track of the tractor A is actuated, its forward motion will impart rotation to the sprocket 26 and in turn cause the rotation of beveled gear 27. By this means it becomes evident that any rotary motion imparted to the beveled gear 27 can readily be imparted to either one of the pinions 14 and 15 and regardless of which of the pinions is in fact rotated, rotation will be imparted to the worm 12 and to the worm gear 30. By means of the connecting rod 31, the rotary motion of the foregoing train of gears is translated to reciprocatory motion so that the side beam 2 may be raised or lowered to a distance determined by the throw of the crank worm wheel 30.

In Figure 5 the uppermost and lowermost position which the blade 1 may assume from its normal horizontal position is shown diagrammatically. It also will be seen from Figure 5 that although but one side of the frame and the blade is raised or lowered by means of the apparatus heretofore described, the position of the other side of the frame and blade is changed to a slight degree. This is possible because the stub shaft (not shown), on which the companion side beam (not shown) of the blade-supporting frame is secured, acts as a pivot for the frame when beam 2 is either raised or lowered and therefore it necessarily follows that the companion beam (not shown) and the other end of the blade will be angled to a degree proportionate with the amount of angle assumed by the end of the blade nearest side beam 2.

In Figures 6 to 10 inclusive, there is shown apparatus for tilting the scraper or bulldozer blade possessing slightly different structural characteristics but embodying the principles of my invention. The power for raising and lowering the beam 2 is not obtained from the track of the tractor A but is derived from one of the tractor-driving sprockets of the tractor A by attaching to the side of the driving sprocket, indicated for purposes of illustration by reference character 34, a gear ring 35 which is fixedly secured to the tractor-driving sprocket in any desirable manner and which surrounds the sprocket hub shown in dotted line at 36. A large gear wheel 37 is secured to shaft 25 and is positioned in direct alignment and is at all times in mesh with the gear ring 35. It is evident from the foregoing that the rotary motion of the tractor-driving sprocket 34 is transmitted to the large gear wheel 37 through the intervention of gear ring 35 so that the beveled gear 27 is rotated and the rotary motion is transmitted to the worm 12 in a manner heretofore pointed out in describing the invention disclosed in Figures 1 to 4 inclusive of the drawings. A supporting bracket 38 is secured to the track frame of tractor A in any desirable manner. Supporting bracket 38 has three bearings 39, 40 and 41 extending outwardly therefrom in direct alignment with each other. A shaft 42 is rotatably disposed within bearings 39, 40 and 41 and collars 40' and 41' surrounding shaft 42 prevent any axial movement thereof. The lower part of the shaft 42 has a worm thread formed therein, as shown at 43, and a worm wheel 44 is secured to the top portion of the shaft 42, so that it may at all times mesh and be driven by the worm 12.

Also formed in the supporting bracket 38 is a vertically-disposed groove 45 and a vertically-disposed slot 46 spaced apart from each other but in registerable alignment, as shown in Figure 9, so that side beam 2 can easily enter the space between them, as shown in Figure 10. An internally threaded split collar 47 is appropriately secured between the sides of and near the end 40 of side beam 2 and is positioned so that it is in registerable alignment and in threadable engagement with the threaded portion 43 of shaft 42. A pair of oppositely disposed stub shafts or pins 49 and 50 extend in direct alignment with each other from collar 47 and may be made integral with or secured in any desirable manner to the collar sections. These pins pass through openings formed through the sides of the beam and are slidably confined in groove 45 and slot 46 respectively. It is now evident that, by the rotation of the worm wheel 44, the side beam 2 may be raised and lowered through the rotation of the shaft 42 and the threadable connection of the collar 47 therewith, permitting the pins 49 and 50 to move up or down, as the case may be, in their respective groove and slot. The blade 1 and its supporting frame will respond to the foregoing described apparatus to produce the conditions diagrammatically shown in Figure 5 and heretofore pointed out in the first paragraph of page 11 of this specification. By this arrangement of the elements, the rearward thrust, necessarily given to the side beam 2 when blade 1 is forced to cut into the terrain being worked, is taken on the pins 49 and 50 and on the supporting bracket 38 and not on the shaft 42 and collar 47.

There is shown in Figures 11 to 15 inclusive apparatus for tilting the blade and its supporting frame which possesses somewhat modified structural characteristics but which performs substantially the same functions that are performed by the apparatus for tilting the bulldozer blade heretofore described. The control and power transmission mechanism is identical with that heretofore described in connection with the apparatus shown in Figures 6 to 10 inclusive and therefore will not be described in connection with the description of the structural characteristics of the rest of the apparatus shown in Figures 11 to 15 inclusive. This apparatus includes the usual frame consisting of a pair of side beams 51

and 51' disposed one on each side of the tractor. The rear end of each side beam is pivotally supported on the track frames of the tractor by the pins 6, only the one supporting side beam 51 being shown, and the front end of each side beam is pivotally connected to the blade 52 as shown at 53. A bearing block 54 is welded or otherwise secured to the side beam 51 near the pivotal connection of the side beam to one of the track frames of the tractor. A cylindrical member 55 is movably confined in bearing block 54 and is held therein by thrust collars 56 and 57. The interior of the cylindrical member 55 has an internal thread formed therein as shown at 58. A spline 59 is joined by universal joints 60 and 61 to the cylindrical member 55 and shaft 11 respectively so that when shaft 11 is rotated the cylindrical member 55 also is rotated.

A sliding member 62 is slidably disposed and guided on side beam 51 and a rod 63 is secured to the top of the sliding member 62. Rod 63 is externally threaded at its other end as shown at 64 and this threaded portion is at all times in engagement with the internal thread 58 formed in the interior of the cylindrical member 55. It at once becomes clear that upon the rotation of the internally threaded cylindrical member 55 the rod 63 will be drawn into or out of the interior of the cylindrical member 55, depending on the direction of rotation of member 55, and thereby force the sliding member 62 to travel towards or away from the bearing block 54.

A thrust brace 65 is pivotally secured to the blade 52 as shown at 66 and to the top of the sliding member 62 as shown at 67. The other end of the blade 52 is braced against appreciable movement by means of a brace, not shown, disposed between the blade and the side beam 51'. When it is desired to tilt the blade so that it will assume the position shown in Figure 12 and the dotted line position as shown at 68 in Figure 13, the sliding member 62 is forced to move forwardly on beam 51 from its normal position as shown in Figure 11 by means of the rotation of the cylindrical member 55 forcing the rod 63 out of its interior 58. This forward thrust must necessarily be taken by the brace 65 and the thrust between the thrust brace and the forward portion of the side beam 51 causes the blade 52 and the whole side beam 51 to be raised, as shown, while the other side of the blade and its side beam remain in substantially the same position except that there is created a slight twist thereon to the right. When it is desired that the blade 51 assume the position shown in dotted lines at 69 in Figure 13, the sliding member 62 is caused to move rearwardly on side beam 51 by rotating cylindrical member 55 and causing it thereby to pull the rod 63 into the interior 58. Of course, it is obvious that the desired degree of tilt on blade 52 is determined by the amount of forward or rearward movement of the sliding member 62 from its normal position on the side beam 51 as shown in Figure 11.

Operation

From a reading of the foregoing description and an examination of the preferred embodiment of the invention disclosed in Figures 1 to 4 inclusive, it will be seen that, in order to tilt blade 1 to the maximum degrees of tilt shown in Figure 5 or to any degree less than the maximum, rotation is imparted to the main beveled gear and in turn transmitted to the train of gears; and through the intervention of the connecting rod 33, the side beam 2 is either raised or lowered. Since it is desired to permit the operator of the tractor to tilt the blade 1 during the forward travel of the tractor and while the bulldozer is biting into the terrain being worked without the necessity of the operator's leaving his seat, the gear shifting mechanism employed allows the blade to be tilted either to the right or to the left by translating and transmitting the power derived from the track of the tractor, as heretofore stated, to raise or lower the side beam 2.

The operation of the first modified embodiment, heretofore described and disclosed in Figures 6 to 10 inclusive, is substantially the same, except that the blade 1 and the beam 2 is raised or lowered by rotating shaft 42 to which the collar 47 is threadably engaged. Finally, the tilting of the blade 52 by the second modified embodiment to assume the position shown in dotted lines in Figure 13 is accomplished by the use of a sliding member slidably disposed on the side beam 51 that has a rod connected to it which, in turn, has its free end forced inwardly or outwardly from the threaded interior of the cylindrical member 55 that is rotated and derives its power from the shaft operated by the train of gears and which, in turn, derives its power from the driving sprocket of the tractor A.

In all of the embodiments heretofore described and shown in the drawings, the raising or lowering of the blade can be and is intended to be done while the tractor and its bulldozer assembly is traveling forwardly and is performing the task of cutting and grading roads and trails.

From the above description it will be readily seen that blade-tilting apparatus has been produced which can substantially fulfill the objects of the invention set forth herein. The invention has been described in conection with a number of illustrated embodiments possessing definite structural characteristics and forms. To these details of disclosure, the invention, of course, is not limited, since what is claimed as new and what is desired to be secured by Letters Patent is set forth in the appended claims.

I claim:

1. In apparatus of the class described, comprising, in combination with the running gear of a conventional type of tractor and the bulldozer-blade supporting frame, of means operatively associated with the running gear of the tractor and one side of the frame for raising or lowering that side of the frame to thereby raise or lower the bulldozer blade into different angular positions relative to the front of the tractor, and means associated with the first-mentioned means for selectively connecting said means into operative relationship with the running gear of the tractor.

2. In apparatus of the class described, comprising, in combination with one of the tracks of a conventional type of tractor and the bulldozer-blade supporting frame, of means operatively associated with one of the tracks of the tractor and one side of the frame for raising or lowering that side of the frame to thereby raise or lower the bulldozer blade into different angular positions relative to the front of the tractor, and means associated with the first-mentioned means for selectively connecting said means into operative relationship with said track of the tractor.

3. In apparatus of the class described, comprising, in combination with one of the driving

sprockets of a conventional type of tractor and the bulldozer-blade supporting frame, of means operatively associated with said driving sprocket of the tractor and with one side of the frame for raising or lowering that side of the frame to thereby raise or lower the bulldozer blade into different angular positions relative to the front of the tractor, and means associated with the first-mentioned means for selectively connecting said means into operative relationship with said driving sprocket of the tractor.

4. In apparatus of the class described, comprising, in combination with the running gear of a conventional type of tractor and the bulldozer-blade supporting frame, of a train of gears, means operatively connected to the running gear of the tractor for transmitting power from the tractor to the train of gears, means associated with the train of gears and one side of the frame for raising or lowering that side of the frame to thereby raise and lower the bulldozer blade into different angular positions relative to the front of the tractor, and means associated with the train of gears for selectively connecting some of said gears into operative relationship with the power transmitting means.

5. In apparatus of the class described, comprising, in combination with one of the tracks of a conventional type of tractor and the bulldozer-blade supporting frame, of a train of gears, means operatively connected to one of the tracks of the tractor for transmitting power from the tractor to the train of gears, means associated with the train of gears and one side of the frame for raising or lowering that side of the frame to thereby raise and lower the bulldozer blade into different angular positions relative to the front of the tractor, and means associated with the train of gears for selectively connecting some of said gears into operative relationship with the power transmitting means.

6. In apparatus of the class described, comprising, in combination with one of the driving sprockets of a conventional type of tractor and the bulldozer-blade supporting frame, of a train of gears, means operatively connected to one of the driving sprockets of the tractor for transmitting power from the tractor to the train of gears, means associated with the train of gears and one side of the frame for raising or lowering that side of the frame to thereby raise and lower the bulldozer blade into different angular positions relative to the front of the tractor, and means associated with the train of gears for selectively connecting some of said gears into operative relationship with the power transmitting means.

7. In apparatus of the class described, comprising, in combination with a conventional type of tractor and a bulldozer-blade supporting frame, of a train of gears, means operatively connected to the running gear of the tractor for transmitting power from the tractor to the train of gears, means associated with the train of gears and one side of the frame for raising or lowering that side of the frame to thereby raise or lower the bulldozer blade into different angular positions relative to the front of the tractor, and manually operative means associated with the train of gears for selectively connecting some of said gears into operative relationship with the power transmitting means.

8. Apparatus for moving a bulldozer blade into desirable working positions, comprising, in combination with a conventional type of tractor, its running gear and the bulldozer-blade mounting frame, of means operatively associated with the running gear of the tractor and one side of the frame for raising or lowering that side of the frame to thereby raise or lower the bulldozer blade into different angular positions relative to the front of the tractor, said means having driving and driven shafts and cooperative gears secured thereon, and clutch means associated with the driven shaft of the first-mentioned means for selectively connecting the driving shaft into operative relationship with the driven shaft for determining the direction of rotation of the driven shaft and the gears secured thereon.

9. Apparatus for moving a bulldozer blade into desirable working positions, comprising, in combination with a conventional type of tractor, its running gear and the bulldozer-blade mounting frame, of means operatively associated with the running gear of the tractor and one side of the frame for raising or lowering that side of the frame to thereby raise or lower the bulldozer blade into different angular positions relative to the front of the tractor, said means having driving and driven shafts and cooperative gears secured thereon, means for rotating the driving shaft, and clutch means associated with the driven shaft of the first-mentioned means for selectively connecting the driving shaft into operative relationship with the driven shaft for determining the direction of rotation of the driven shaft and the gears secured thereon.

10. Apparatus for moving a bulldozer blade into desirable working positions, comprising, in combination with a conventional type of tractor, its running gear and the bulldozer-blade mounting frame, of means operatively associated with the running gear of the tractor and one side of the frame for raising or lowering that side of the frame to thereby raise or lower the bulldozer blade into different angular positions relative to the front of the tractor, said means having driving and driven shafts and cooperative gears secured thereon, means for rotating the driving shaft, clutch means associated with the driven shaft of the first-mentioned means for selectively connecting the driving shaft into operative relationship with the driven shaft for determining the direction of rotation of the driven shaft and the gears secured thereon, and manually actuated means for engaging or disengaging the clutch means.

11. Apparatus for moving a bulldozer blade into desirable working positions, comprising, in combination with a conventional type of tractor and its running gear, of a bulldozer-blade mounting frame comprising a pair of side beams secured at their rearward ends to each side of the track frame of the tractor, a ground-working blade mounted to its supporting frame forwardly of the tractor, and means secured to one side of the tractor and operatively associated with its running gear and with one of the side beams of the blade-supporting frame for moving the blade and that side of the frame into different operative positions relative to the front of the tractor.

12. Apparatus for moving a bulldozer blade into desirable working positions, comprising, in combination with a conventional type of tractor and its running gear, of a bulldozer-blade mounting frame comprising a pair of side beams secured at their rearward ends to each side of the track frame of the tractor, a ground-working blade mounted to its supporting frame forwardly of the tractor, means secured to one side of the tractor and operatively associated with its run-

ning gear and with one of the side beams of the blade-supporting frame for moving the blade and that side of the frame into different operative positions relative to the front of the tractor, and means associated with the first-mentioned means for selectively connecting said means into operative relationship to the running gear of the tractor.

13. Apparatus for moving a bulldozer blade into desirable working positions, comprising, in combination with a conventional type of tractor and its running gear, of a bulldozer-blade mounting frame, comprising a pair of side beams secured at their rearward ends to each side of the track frame of the tractor, a vertically-slotted member secured at the end of one of said side beams, a ground-working blade mounted to its supporting frame forwardly of the tractor, means secured to one side of the tractor and operatively associated with its running gear and with the vertically-slotted member of one of the beams of the blade-supporting frame for moving the blade and that side of the frame into different operative positions relative to the front of the tractor, and manually operative means associated with the first-mentioned means for selectively connecting said means into operative relationship with the running gear of the tractor.

14. Apparatus for raising or lowering one end of a bulldozer blade to vary the working angle of the blade relative to the ground, comprising a casing, a driving shaft extending into and from the casing, a driving sprocket secured to one end of said shaft, a beveled pinion secured to the other end of said shaft, a driven shaft journaled in said casing and having one end extending outwardly therefrom, said driven shaft lying in the same plane but positioned at right angles to the driving shaft, a worm keyed to the extended end of the driven shaft, a worm gear at all times in mesh with said worm, a vertically slotted member secured to the end of one of the side beams of the blade mounting frame, a rod secured to the worm gear and to the vertically-slotted member, whereby upon the rotation of the worm gear, the side beam will be raised or lowered, and means slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from the sprocket to the worm gear.

15. Apparatus characterized as in claim 14 wherein the means that is slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from the sprocket to the worm gear comprises a sleeve slidably positioned on the driven shaft, and a pair of beveled pinions secured to the end of said sleeve, said pinions having the same structural characteristics and adapted to mesh, one at a time, with the beveled pinion secured to the driving shaft.

16. Apparatus for raising and lowering one end of a bulldozer blade to vary the working angle of the blade relative to the ground, comprising a casing, a driving shaft extending into and from the casing, a driving sprocket secured to one end of said shaft, a beveled pinion secured to the other end of said shaft, a driven shaft journaled in said casing and having one end extending outwardly therefrom, said driven shaft lying in the same plane but positioned at right angles to the driving shaft, a worm keyed to the extended end of the driven shaft, a worm gear at all times in mesh with said worm, a vertically-slotted member secured to the end of one of the side beams of the blade mounting frame, a rod secured to the worm gear and to the vertically-slotted member, whereby upon the rotation of the worm gear, the side beam will be raised or lowered, means slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from the sprocket to the worm gear, and manually operated means for shifting the last-mentioned means.

17. Apparatus for raising and lowering one end of a bulldozer blade to vary the working angle of the blade relative to the ground, comprising a casing, a driving shaft extending into and from the casing, a gear wheel secured to one end of said shaft, a beveled pinion secured to the other end of said shaft, a driven shaft journaled in said casing and having one end extending outwardly therefrom, said driven shaft lying in the same plane but positioned at right angles to the driving shaft, a worm keyed to the extended end of the driven shaft, a worm gear at all times in mesh with said worm, a vertically positioned shaft for holding said worm gear, said shaft having an external thread around its lower portion, an internally threaded collar secured to the end of the side beam and threadably engageable by the externally threaded shaft, a pair of directly aligned pins extending from opposite sides of the collar, a bracket for supporting said externally threaded shaft and said pins, said bracket having a groove and a slot registerably aligned into which the pins fit, whereby, upon the rotation of the threaded shaft by the worm gear, the side beam will be raised or lowered, and means slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from the gear wheel to the worm gear.

18. Apparatus characterized as in claim 17 wherein the means that is slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from the sprocket to the worm gear comprises a sleeve slidably positioned on the driven shaft, and a pair of beveled pinions secured to the ends of said sleeve, said pinions having the same structural characteristics and adapted to mesh, one at a time, with the beveled pinion secured to the driving shaft.

19. Apparatus for raising and lowering one end of a bulldozer blade to vary the working angle of the blade relative to the ground, comprising a casing, a driving shaft extending into and from the casing, a gear wheel secured to one end of said shaft, a beveled pinion secured to the other end of said shaft, a driven shaft journaled in said casing and having one end extending outwardly therefrom, said driven shaft lying in the same plane but positioned at right angles to the driving shaft, a worm keyed to the extended end of the driven shaft, a worm gear at all times in mesh with said worm, a vertically positioned shaft for holding said worm gear, said shaft having an external thread around its lower portion, an internally threaded collar secured to the end of the side beam and threadably engageable by the externally threaded shaft, a bracket for supporting said externally threaded shaft and said collar, means formed in said bracket and associated with said collar whereby, upon the rotation of the threaded shaft by the worm gear, the side beam will be raised or lowered, means slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from

the sprocket to the worm gear, and manually operated means for shifting the last-mentioned means.

20. In apparatus of the class described, in combination with a conventional type of tractor or similar vehicle, an approximately U-shaped frame movably connected to said tractor or similar vehicle, said frame comprising a pair of side beams disposed on each side of the vehicle and extending forwardly thereof, a vertically-slotted member secured to the end of one of the side beams, a scraper or bulldozer blade connected to the front of said frame, a gear casing secured to the side of the tractor or similar vehicle, a plurality of selectively coacting gears disposed in said casing, manually actuated means associated with said gears for permitting the operator of the tractor to selectively determine the actuation of said gears, means for taking power from the tractor for operating said gears, and means secured to the vertically-slotted member for translating and transmitting the rotary motion of the gears to reciprocatory motion and thereby either raise or lower one side of said frame and vary the angular position of the blade relative to the ground.

21. In apparatus of the class described, in combination with a conventional type of tractor or similar vehicle, an approximately U-shaped frame movably connected to said tractor or similar vehicle, said frame comprising a pair of side beams disposed on each side of the vehicle and extending forwardly thereof, a bracket secured to the side of the tractor, said bracket having formed therein an elongated groove and an elongated slot vertically disposed and registerably aligned with each other, means secured to one of said beams and slidably associated with said bracket for supporting and permitting the raising and lowering of said beam, a scraper or bulldozer blade connected to the front of said frame, a gear casing secured to the side of the tractor or similar vehicle to which the bracket is secured, a plurality of selectively co-acting gears disposed in said casing, manually actuated means associated with said gears for permitting the operator of the tractor to selectively determine the actuation of said gears, means for taking power from the tractor for operating said gears, and means threadably secured to the side beam supporting means and operatively connected to the gears for raising or lowering said side beam and thereby vary the angular position of the blade relative to the ground.

22. Apparatus for raising and lowering one end of a bulldozer blade to vary the working angle of the blade relative to the ground, comprising a casing, a driving shaft extending into and from the casing, a gear wheel secured to one end of said shaft, a beveled pinion secured to the other end of said shaft, a driven shaft journaled in said casing and having one end extending outwardly therefrom, said driven shaft lying in the same plane but positioned at right angles to the driving shaft, a side beam, a bearing block secured to the side beam, an internally threaded cylindrical member rotatably confined within the bearing block, a spline universally secured to one end of the internally threaded cylindrical member and to the driven shaft, a rod threadably secured to the internally threaded cylindrical member, means secured to the rod slidably positioned on the beam and indirectly connected to the blade, whereby, upon the rotation of the threaded cylindrical member, the side beam and the blade will be raised or lowered, and means slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from the gear wheel to the internally threaded cylindrical member.

23. Apparatus characterized as in claim 22, including manually operated means for shifting the last-mentioned means.

24. Apparatus for raising and lowering one end of a bulldozer blade to vary the working angle of the blade relative to the ground, comprising a casing, a driving shaft extending into and from the casing, a gear wheel secured to one end of said shaft, a beveled pinion secured to the other end of said shaft, a driven shaft journaled in said casing and having one end extending outwardly therefrom, said driven shaft lying in the same plane but positioned at right angles to the driving shaft, a side beam, a bearing block secured to the side beam, an internally threaded cylindrical member rotatably confined within the bearing block, a spline universally secured to one end of the internally threaded cylindrical member and to the driven shaft, a rod threadably secured to the internally threaded cylindrical member, a member slidably positioned upon said side beam and directly secured to said rod, a thrust-receiving brace directly secured to said sliding member and to the blade, whereby, upon the rotation of the threaded cylindrical member, the side beam and the blade will be raised or lowered, and means slidably positioned upon the driven shaft adapted to permit the selective transmission of rotary motion from the gear wheel to the internally threaded cylindrical member.

25. In apparatus of the class described, in combination with a conventional type of tractor or similar vehicle, an approximately U-shaped frame movably connected to said tractor or similar vehicle, said frame comprising a pair of side beams disposed on each side of the vehicle and extending forwardly thereof, a scraper or bulldozer blade connected to the front of said frame, a gear casing secured to one side of the tractor or similar vehicle, a plurality of selectively coacting gears disposed in said casing, manually actuated means associated with said gears for permitting the operator of the tractor to selectively determine the actuation of said gears, means for taking power from the tractor for operating said gears, an internally threaded cylindrical member secured to the side beam disposed on the same side of the tractor which carries the gear casing, means associated with said internally threaded cylindrical member and operatively connected to the gears for rotating said member, and means slidably disposed on said beam and connected to the blade and to said internally threaded cylindrical member, whereby, upon the forward or rearward movement of said slidable member caused by the rotation of said cylindrical member, the blade and the side beam will be raised or lowered accordingly.

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