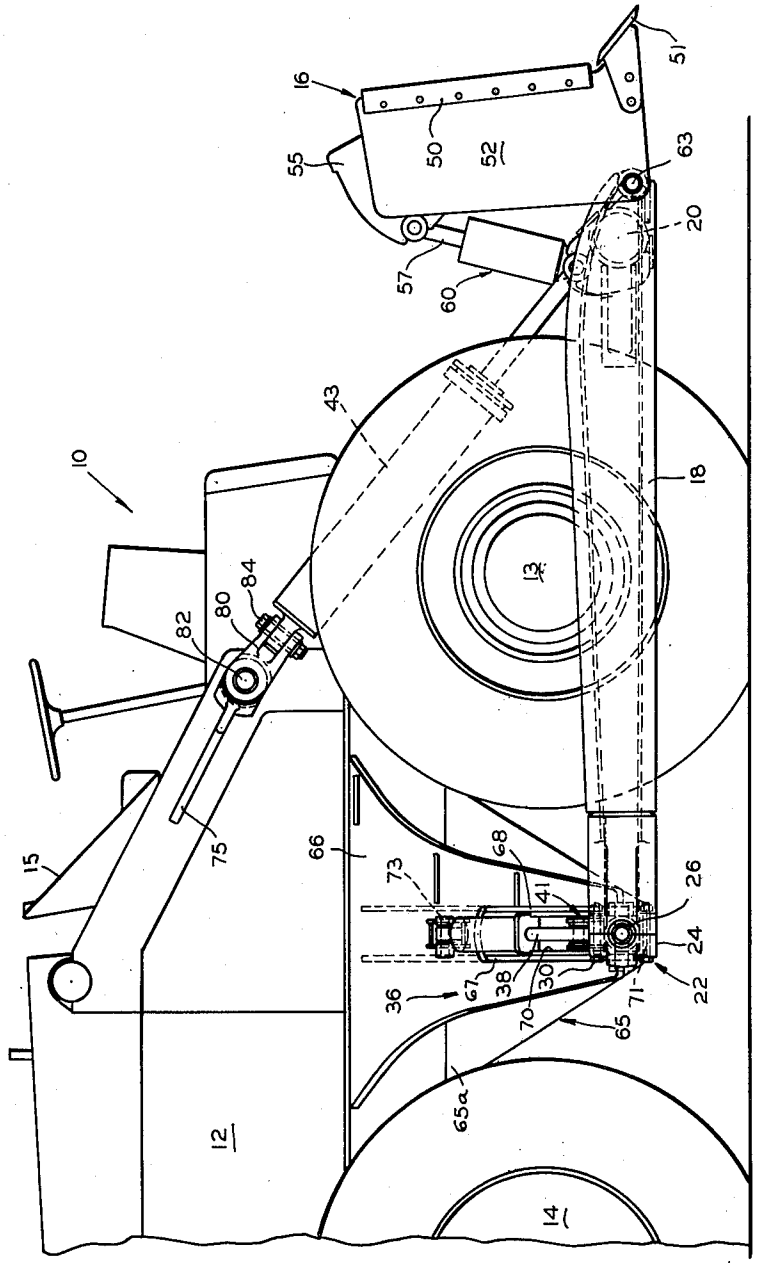
Jan. 30, 1962 P. F. McADAMS 3,018,573

TILTING BULLDOZER BLADE

Filed June 12, 1957 5 Sheets-Sheet 1

FIG. 1



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TILTING BULLDOZER BLADE

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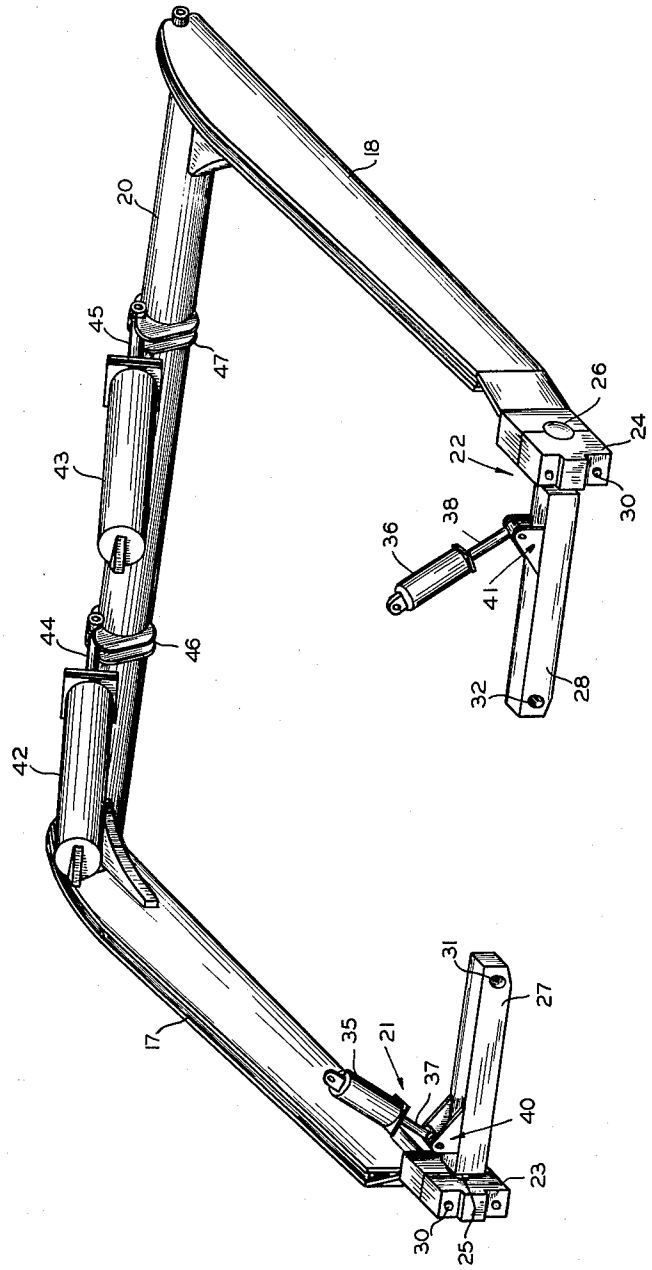
FIG. 2



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TILTING BULLDOZER BLADE

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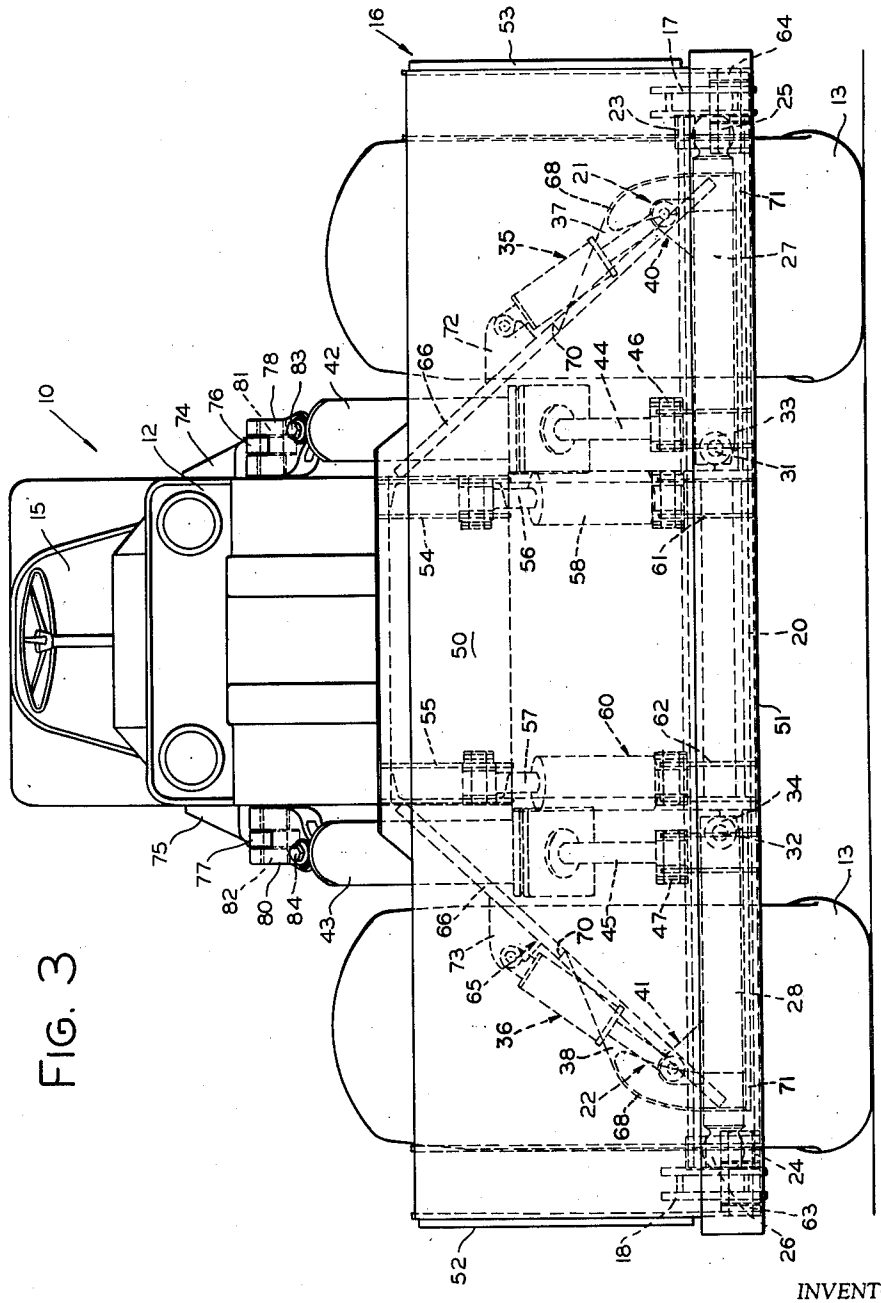

FIG. 3

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TILTING BULLDOZER BLADE

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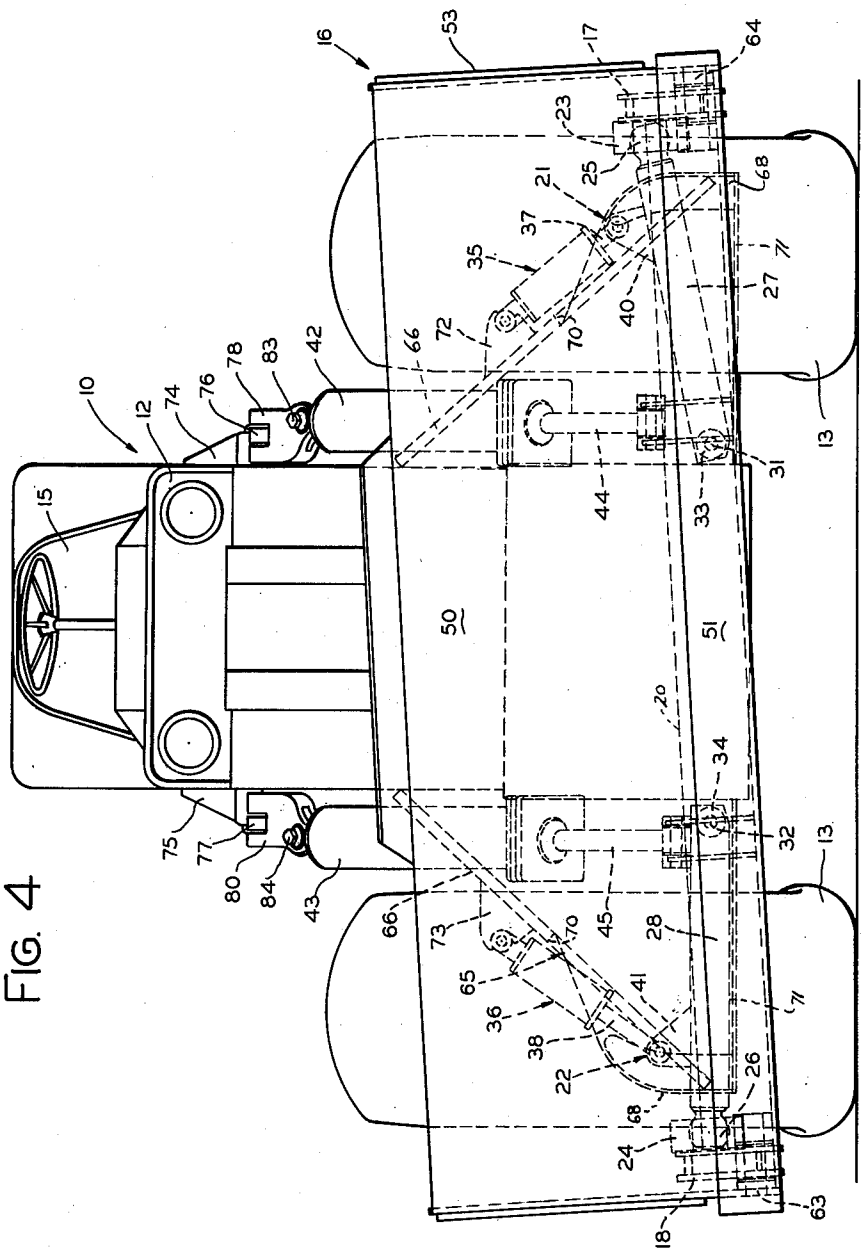

FIG. 4

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TILTING BULLDOZER BLADE

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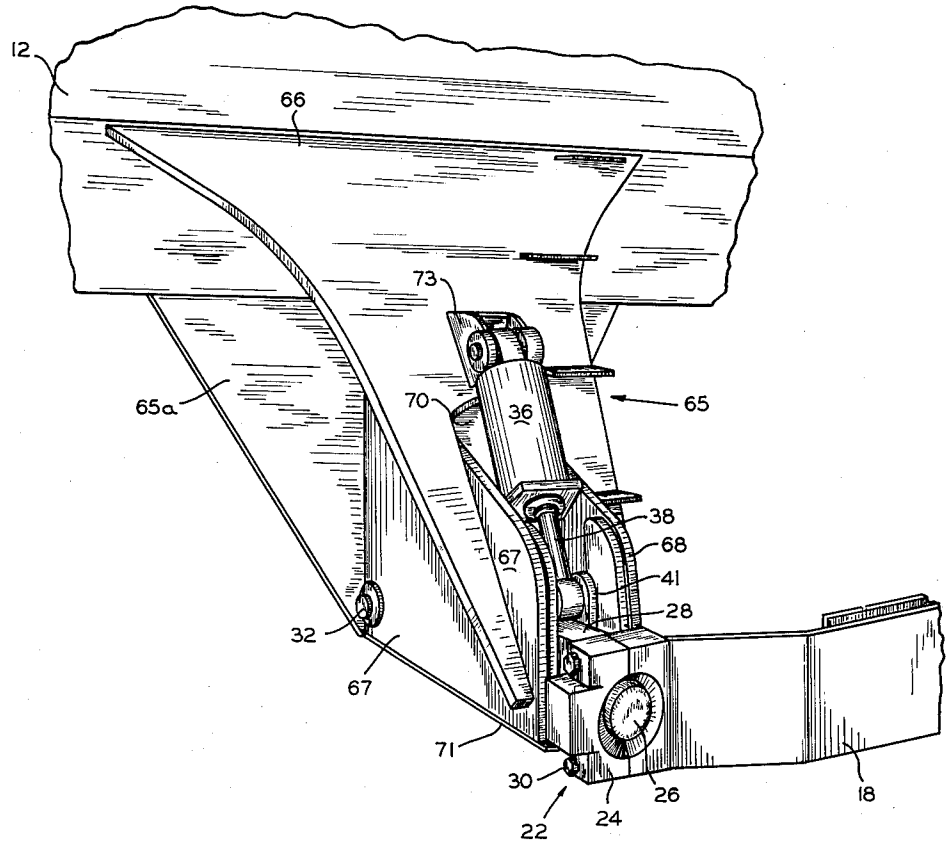
FIG. 5



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United States Patent Office 3,018,573
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3,018,573

TILTING BULLDOZER BLADE

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2 Claims. (Cl. 37—144)

This invention relates to new and useful improvements in tractor mounted bulldozers and more particularly to improved means for effecting tilting of a bulldozer blade.

In a bulldozer of the type for which my invention is most particularly adapted, the blade proper is carried by a U-shaped frame which surrounds the front end of the tractor, the rear ends of the two arms of the frame being pivotally mounted on a common transverse axis with respect to the sides of the tractor to permit selective raising and lowering of the bight portion of the frame by power actuated hydraulic means extending between the tractor and the said bight portion. The blade proper is mounted forwardly of the transverse bight portion of the U-shaped frame on extensions of the two arms, and the top portion of the blade may be connected to the transverse bight portion by power actuated hydraulic means to permit tilting of the blade about a transverse axis, i.e., as referred to hereinafter, to accommodate variation in the pitch of the blade. When using vehicles of this type, it has also been found desirable to dispose one corner of the cutting edge of the blade lower than the other, i.e., to tilt the blade about the longitudinal axis of the tractor, for certain operations. In this latter respect, it may seem adequate simply to pivotally mount the blade on the longitudinal axis of the tractor, but it has been further found that such arrangement requires expensive and complicated stabilizing mechanisms and the like to adequately control the blade and insure its return to horizontal. One means of inexpensively and adequately tilting the cutting edge of the blade has been described and claimed in the United States patent application of Christensen and McAdams, Serial No. 555,534, filed December 27, 1955, now Patent No. 2,839,849 entitled "Adjustable Bulldozer" in which the tilting of the cutting edge of the blade is accomplished by the deformation or the warping of the blade itself by the use of a single centrally located power actuated means and strut members suitably connected to the arms of the therein disclosed U-shaped frame and the blade.

The present invention is an improvement over the Christensen and McAdams invention and involves the utilization of a pair of power actuated means to raise and lower, preferably one at a time, the pivotal mounting point of the arms of the U-shaped frame to tilt the transverse member of the U-shaped frame and thus the blade. With this arrangement, the centrally located cylinder and the strut means attached to the arms of the U-shaped frame are eliminated and additional stabilizing means required in other prior art devices is also eliminated.

Accordingly, it is a primary object of this invention to provide an improved, simple and inexpensive means for tilting the cutting edge of a bulldozer blade out of the horizontal plane.

A further object of this invention is to provide adjusting means at the pivotal mounting points of the arms of the U-shaped frame attached to the tractor to move either one of the pivot points to cause the U-shaped frame, and thus the bulldozer blade, to be tilted.

A still further object of the invention is the provision of improved blade tilting means as aforesaid wherein the means for adjusting the pivotal mounting points of the bulldozer frame comprise power actuated jacks, preferably hydraulic jacks, thereby to afford a bulldozer blade assembly that is power actuated in all respects and is

adapted to be controlled from a remote location, such as the driver's seat, as to height, pitch and tilt. Moreover, by virtue of the defined structure, the blade and frame actuating means tend to retain the blade fixedly in adjusted position, thereby to accommodate utilization for the performance of useful functions of the resistance of the frame to warping, and warping of the frame in use.

Other objects and advantages of this invention will become apparent to those skilled in the art in view of the following description wherein:

FIG. 1 is a side elevation of the bulldozer blade control arrangement connected to a tractor vehicle;

FIG. 2 is a perspective view showing to advantage the U-shaped frame and the power actuated means for raising and lowering the blade and the power actuated means for tilting the blade;

FIG. 3 is a front elevation of the bulldozer shown in FIG. 1 with the blade in a horizontal position;

FIG. 4 is a front elevation of the bulldozer showing the blade in a tilted position, the pitch adjusting jack means being omitted from this figure to facilitate disclosure of the tilted position of the blade and its frame; and

FIGURE 5 is a perspective view of one of the mounting assemblies for the U-shaped frame, and the power-actuated blade-tilting means associated therewith.

Referring now to the drawings, a tractor vehicle of a well-known type is shown indicated in its entirety by numeral **10** and includes a vehicle body **12** mounted on front and rear wheels **13** and **14** with the conventional front and rear axles driven by a conventional transmission and a differential mechanism (not shown). The vehicle body includes an operator's station **15** having a plurality of conventional controls thereon for operating the tractor vehicle and the bulldozer blade, indicated in its entirety as **16**, connected thereto. While this invention is illustrated in connection with a rubber-tired vehicle, it will be readily understood that it may be applied with equal facility to an endless track or crawler type tractor vehicle as desired.

A U-shaped frame for mounting the blade **16** onto the vehicle comprises (as more clearly shown in perspective in FIG. 2), a pair of longitudinally extending parallel side or pusher arms **17** and **18** rigidly connected near their front ends by a transverse tubular member **20**, comprising in effect a torque tube. A pair of gusset members may be provided between the transverse member **20** and the arms **17** and **18** if desired.

At the opposite ends of the arms **17** and **18** from the transverse tubular member **20** there is provided means, indicated in their entirety as **21** and **22**, for pivotally connecting the arms to the vehicle. These pivotal connecting means **21** and **22** each comprise block-like members **23** and **24**, respectively, each of which is split to form two parts formed internally with a ball-type socket to receive a pair of ball portions **25** and **26** (more clearly shown in FIGS. 3 and 4) to form a universal ball-type joint with inwardly extending arms **27** and **28**. One part of each of the block-like members is suitably permanently affixed to the end of arms **17** and **18** and the other part is respectively attached to its complementary part by any suitable means such as by the bolt and nut assemblies **30**.

The inner ends of the arms **27** and **28** opposite to the ball portions **25** and **26** are each apertured as shown at **31** and **32** to be pivotally connected to the sides of the vehicle as at **33** and **34** (FIGS. 3 and 4). Intermediate the ends of arms **27** and **28**, there is provided a pair of double acting power actuated hydraulic cylinder means or jacks **35** and **36** with piston rods **37** and **38** pivotally connected respectively to the arms **27** and **28** by bracket means, indicated in their entirety as **40** and **41**, comprising a pair of plates and suitable sleeve means. By this construction, the cylinder means **35** and **36** are adapted to move the

arms 27 and 28 arcuately in a vertical plane about their pivots 33 and 34 for a purpose later to be described.

In a similar manner, intermediate the ends of the transverse bar 20 there is provided a pair of upwardly and rearwardly extending hydraulically interconnected double acting power actuated hydraulic cylinder means or jacks 42 and 43 each of which is provided with a movable piston rod, 44 and 45 respectively, pivotally connected to the tube 20 by suitable brackets, indicated in their entirety as 46 and 47, and comprising a pair of plates and sleeve means. In this manner, the piston rods 44 and 45 are able to move in a direction transverse to the axis of the tube 20 and, by power actuated extension or retraction of the piston rods 44 and 45, the tube 20 may be raised or lowered as desired.

The bulldozer blade, indicated in its entirety as 16, is a built-up structure which generally includes a moldboard 50, a longitudinal cutting edge 51 adjacent the bottom of the moldboard, and a pair of side plates 52 and 53 (plate 52 being clearly shown in FIG. 1) permanently connected to opposite ends of the moldboard. A pair of brackets 54 and 55, which are permanently connected to the top of the moldboard and the back side thereof, provide means for pivotally connecting to the blade the piston rods 56 and 57 of a pair of double acting power actuated hydraulic cylinder means 58 and 60. The other ends of the cylinder means are suitably pivotally connected by bracket means 61 and 62 to the transverse tube 20. By this means, the bulldozer blade 16 may be tilted about its transverse or lateral axis to raise and lower the blade about a pair of coaxial pin assemblies 63 and 64 (63 being clearly shown in FIG. 1) located in extensions of the side arms 17 and 18, whereby the blade is adjustably mounted on the frame to accommodate variation in the pitch of the blade.

Turning now to FIG. 1 there can be seen a substantially triangular shaped angularly disposed mounting assembly, indicated in its entirety as 65, permanently and rigidly affixed to the sides of the tractor body 12. Mounting assembly 65 comprises a triangular vertical wall 65*a*, a top plate 66 inclined outwardly and downwardly with respect to the side of the tractor and a pair of parallel vertical plates 67, 68 extending outwardly from the wall 65*a* and the tractor body 12 through the plate 66 and forming therewith a pyramidal type structure. The plate 66 is formed with an opening 70 (shown in FIGS. 3 and 4) through which the plates 67 and 68 extend and which is sufficiently large to permit free movement therethrough of the power cylinder means 36 and bracket 41. A similar pyramidal structure with opening to accommodate power cylinder means 35 and bracket 40 is located on the opposite side of the tractor. Preferably, both structures 65 include a horizontal base wall 71 between the plates 67 and 68 to form therewith a channel within which the respective frame support arm 27, 28 is guidably mounted. A pair of bracket assemblies 72 and 73 (see FIGS. 3 and 4) comprising suitable plates and sleeve means form a permanent pivotal connection for the ends of the power cylinder means 35 and 36 for moving the ball joint assemblies 21 and 22 upwardly and downwardly.

To rigidly connect yet permit universal-like action, the power actuated cylinder means or jacks 42 and 43 are connected to the vehicle body 12 by a pair of triangularly shaped brackets 74 and 75 having bearing sleeves 76, 77, respectively, which rotatably mount doubly bifurcated brackets 78 and 80. Brackets 78 and 80 have vertical and transverse pairs of pin members 81 and 82, 83 and 84 respectively, the latter being rotatably connected to the cylinders 42 and 43. By this arrangement, the cylinders are free to move both vertically and horizontally relative to the vehicle body 12. Suitable reinforcing means adjacent the brackets 74 and 75 and any other places about the entire blade tilting arrangement may be provided where necessary or desirable.

In operation, the blade structure 16 may be raised or lowered to any desired position within limits by the hydraulic power actuated cylinder means 42 and 43 from a suitable source of hydraulic pressure (not shown) in the conventional manner by the conventional controls at the operator station 15 and similarly the pitch of the blade itself may be adjusted by the hydraulically actuated power cylinder means 58 and 60 from the same source of hydraulic pressure (not shown) by suitable controls at the operator station 15.

At any given raised or lowered position of the blade 16, and at any pitch adjustment desired, the hydraulic cylinder means 35 or 36 located on the side of the tractor body as described, may be actuated to cause a raising of the pivot point 21 or 22 and tilting of the blade. If it is desired to tilt the right-hand end of the blade edge downwardly (as viewed by the operator), hydraulic power actuated cylinder means 35 is actuated, from the same source of hydraulic pressure as aforesaid, to retract the piston rod 37 and raise pivot point 21. As pivot point 21 is raised, pivot point 22 is fixedly retained in its original position by the channel guide means 65 and the cylinder 36, which then acts as a rigid strut. By virtue of the ball and socket connections 23—25 and 24—26, the frame of the bulldozer attachment commences to pivot or tilt about the ball 26. At this time, the fluid supply line to the hydraulically interconnected cylinders 42 and 43 is closed, and the two cylinders remain in hydraulic intercommunication, so that the raising of the left side of the frame, as caused by raising the pivot point 21, results in movement of the piston rod 44 into the cylinder 42 to force fluid out of the upper end of the cylinder 42 into the upper end of the cylinder 43, whereby the piston rod 45 is extended from the cylinder 43. Thus, the left front corner of the frame is permitted to raise, the right front corner is forced to be lowered to an extent equal to the raising of the left front corner, and the center point of the front transverse member 20 remains essentially in its original position. Consequently, the frame as a whole assumes the position illustrated in FIGURE 4 wherein the left rear corner (as viewed by the operator) is raised a predetermined distance, the left front corner is elevated by approximately half that distance, the center of the transverse member 20 remains in its original position, the right front corner is lowered to substantially the same extent that the left front corner is raised, and the right rear corner is retained at its initial elevation. The frame is thus disposed in a plane that is inclined laterally upward from the right to the left side of the tractor and that is also inclined forwardly downward. Due to the disposition of the frame, the blade 16 is tilted with its right end lowered and its left end raised relative to the original position of the blade.

Likewise, if it is desired to lower the left hand side of the blade, it is only necessary to return the pivot pin 21 to its initial position by means of the hydraulic jack 35 and to actuate the jack 36 to retract piston rod 38 of the cylinder thereby to raise pivot point 22 and cause tilting of the blade downwardly on the left side. In the tilting of the blade in either direction, the cylinder means, other than the one raising the particular end of the side arm, preferably is retained in its extended position.

It is to be noted that this tilting of the blade may be accomplished in any given position and at any pitch adjustment of the blade. The pistons and piston rods of the power actuated cylinder means in this disclosed arrangement are so constructed and arranged to turn slightly in their cylinders and all the connecting brackets permit pivoting to accommodate the tilting of the blade. Too, some of the connections themselves can be loosely fitted as desired to accommodate the tilting.

In any of its positions, the blade is positively restrained by the hydraulic cylinder means and the blade mounting frame. Specifically, each of the cylinders 35 and 36 acts

as a rigid strut positively restraining the respective one of the two rearward corners of the frame against vertical movement. At the same time, the two cylinders 42 and 43 conjointly act to positively restrain the front center point of the frame against the vertical movement. Thus, movement of the blade from an adjusted position is resisted by the resistance of the frame to warping, and is to an extent accommodated by warping of the frame. This is of particular importance when the bulldozer is required to perform an earth moving function principally adjacent one end of the blade. Under such conditions, the blade is tilted to lower the end thereof that is to perform the principal work. As the bulldozer is put to use, especially in hard earth materials such as clay, the blade is forced back toward a horizontal position, which causes warpage of the frame whereby a positive, continuous, downward pressure is created and maintained on the work performing end portion of the blade by the frame. Such pressure is especially beneficial when the bulldozer is operating under adverse conditions which tend to force the blade out of the ground, such as in clay and in removing large rocks and the like. Also under such conditions, the pitch adjusting hydraulic actuators cooperate with the warped or pressure biasing blade frame to work the blade relative to the soil and/or rocks to aid in moving the same.

While means have previously been disclosed for tilting the cutting edge of bulldozer blades such as that described and claimed in the aforementioned co-pending application of Christensen and McAdams, S.N. 555,534 filed December 27, 1955, wherein the tilting is accomplished by means of a strut member and a centrally located hydraulically actuated piston, never before insofar as is known has such a low-cost and relatively simple means as herein described been devised for tilting bulldozer blades and yet accomplish stabilization and adequate control. In addition, the described structure affords a bulldozer that is power actuated in all respects and provides for complete remote control of the blade from the operator's seat.

Although I have illustrated and described but one embodiment of my invention it will be aparent to persons skilled in the art that certain changes in the construction and arrangement of the parts may be made without departing from the scope of my invention as defined by the claims appended hereto and while I have described my invention with reference to a particular direction, it will be understood that this is merely to facilitate description and is not intended to be considered a limitation.

I claim:

1. In a bulldozer vehicle having an operator's station and having a U-shaped frame comprising parallel side arms and a transverse base portion rigidly connecting said side arms forwardly of the vehicle body, means for pivotally mounting the rearward end of each of said parallel side arms on the vehicle, a blade structure pivotally mounted on the front end of said side arms forwardly of the transverse base portion, first double-acting power actuated hydraulic jack means operatively connected to the transverse base portion and the blade structure for adjusting the pitch of the blade, second double-acting power actuated hydraulic jack means operatively connected to the center part of the transverse base portion and to the vehicle for raising and lowering the transverse base portion and the blade structure relative to the vehicle, and third double-acting power actuated hydraulic jack means for moving each of the first-mentioned means upwardly and downwardly with respect to the vehicle, all of said hydraulic jack means being controlled from the operator's station, said second jack means in any adjusted position thereof restraining the center of said transverse base portion against vertical movement, said first and third jack means in any adjusted position thereof comprising substantially rigid struts whereby actuation of either of said third jack means causes tilting of said frame and said blade structure and whereby movement of said blade structure except by said jack means causes warping of said frame so that said frame maintains a downward pressure on the end portion of the blade performing the principal amount of the work.

2. In a bulldozer vehicle having a U-shaped frame comprising parallel side arms and a transverse base portion rigidly connecting said side arms forwardly of the vehicle body, means for pivotally mounting the rearward end of each of said parallel side arms on the vehicle, a blade structure pivotally mounted on the front end of said side arms forwardly of the transverse base portion, double-acting power actuated hydraulic jack means operatively connected to the transverse base portion and the blade structure for adjusting the pitch of the blade, a pair of hydraulically interconnected double-acting power actuated hydraulic jacks operatively connected to the transverse base portion and to the vehicle at equal distances to opposite sides of the longitudinal center line thereof for raising and lowering the blade structure relative to the vehicle, said pair of hydraulically interconnected jacks in any adjusted position thereof positively restraining the center of said transverse base portion against vertical movement, and means comprising a pair of individually operable double-acting power actuated hydraulic jacks connected to the vehicle and respective ones of the first-mentioned means for individually moving the first-mentioned means upwardly and downwardly with respect to the vehicle and for thereby tilting the frame and the blade relative to the vehicle, the last-named jacks in any adjusted position thereof comprising substantially rigid struts whereby movement of said blade except by said jacks causes warping of said frame so that said frame maintains a downward pressure on the end portion of the blade performing the principal amount of the work.

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