May 18, 1954 G. REUTER ET AL 2,678,508

ADJUSTABLE BULLDOZER

Filed June 9, 1950 7 Sheets-Sheet 1

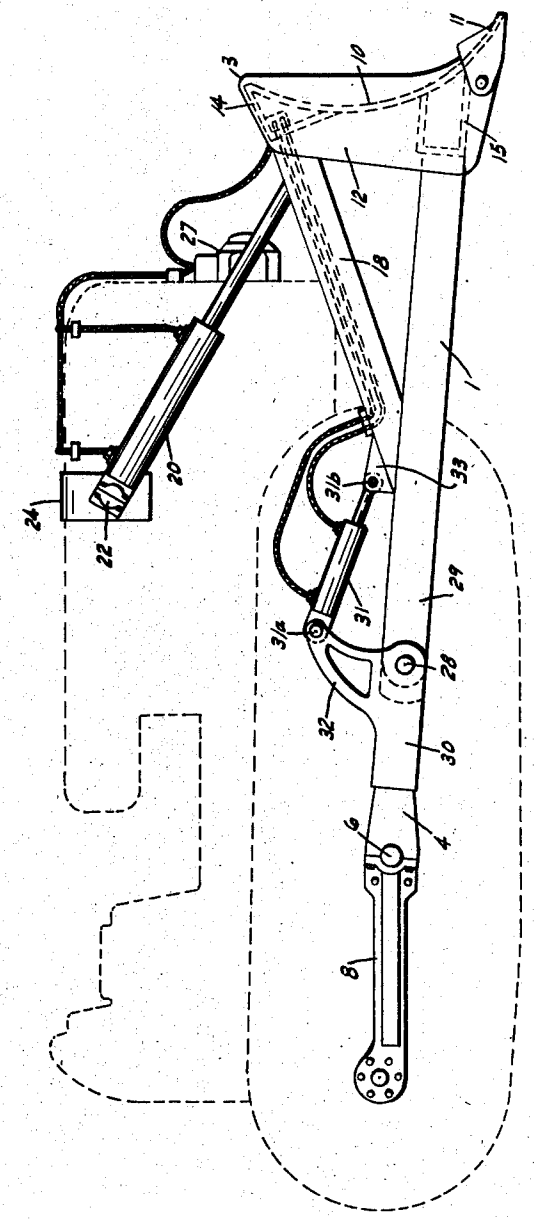


FIG. 1

GOTTFRIED REUTER,
LEO BARNES,
*INVENTORS.*

BY John Adams Thurman

ATTORNEY.

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ADJUSTABLE BULLDOZER

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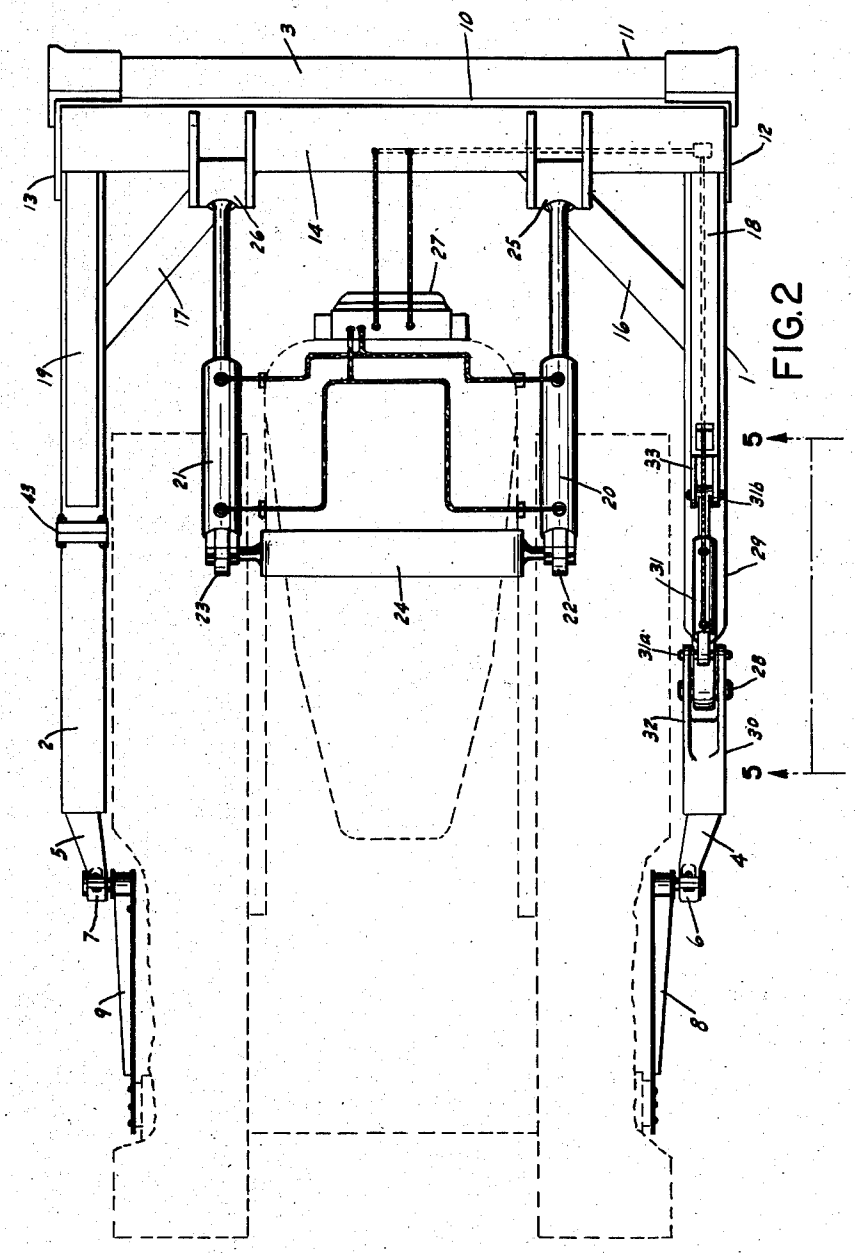

FIG. 2

GOTTFRIED REUTER,
LEO BARNES,
*INVENTORS.*

BY John Adams Thurman

ATTORNEY.

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ADJUSTABLE BULLDOZER

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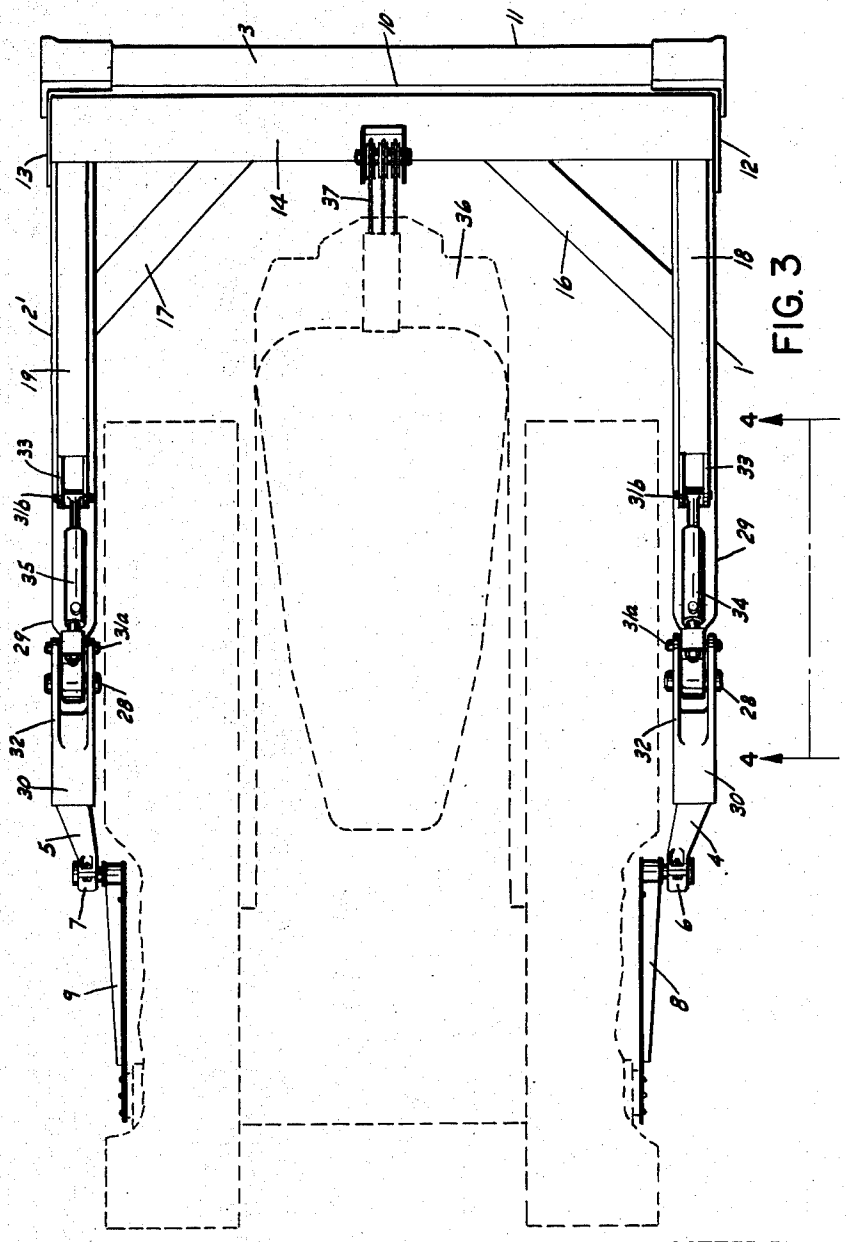


FIG. 3

GOTTFRIED REUTER,
LEO BARNES
*INVENTORS.*

BY John Adams Thierry

ATTORNEY.

May 18, 1954 G. REUTER ET AL 2,678,508

ADJUSTABLE BULLDOZER

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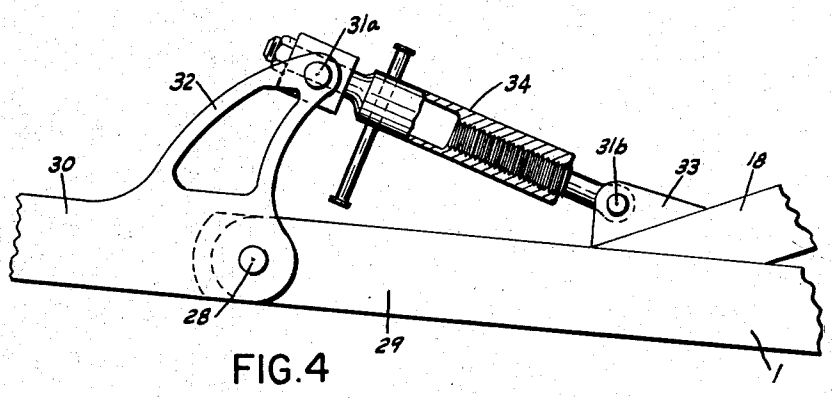


FIG. 4

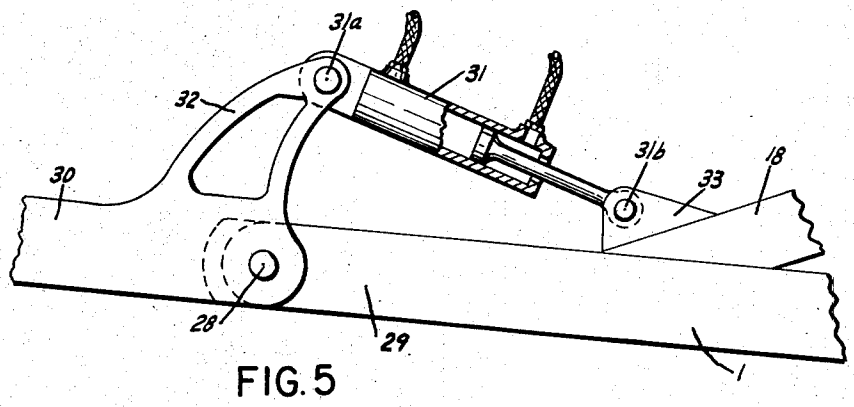


FIG. 5

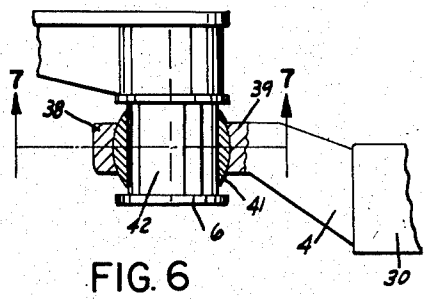


FIG. 6

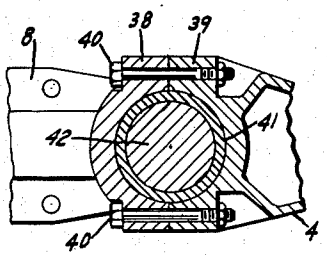


FIG. 7

GOTTFRIED REUTER,
LEO BARNES,
*INVENTORS.*

BY John Adams Thierry

ATTORNEY.

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ADJUSTABLE BULLDOZER

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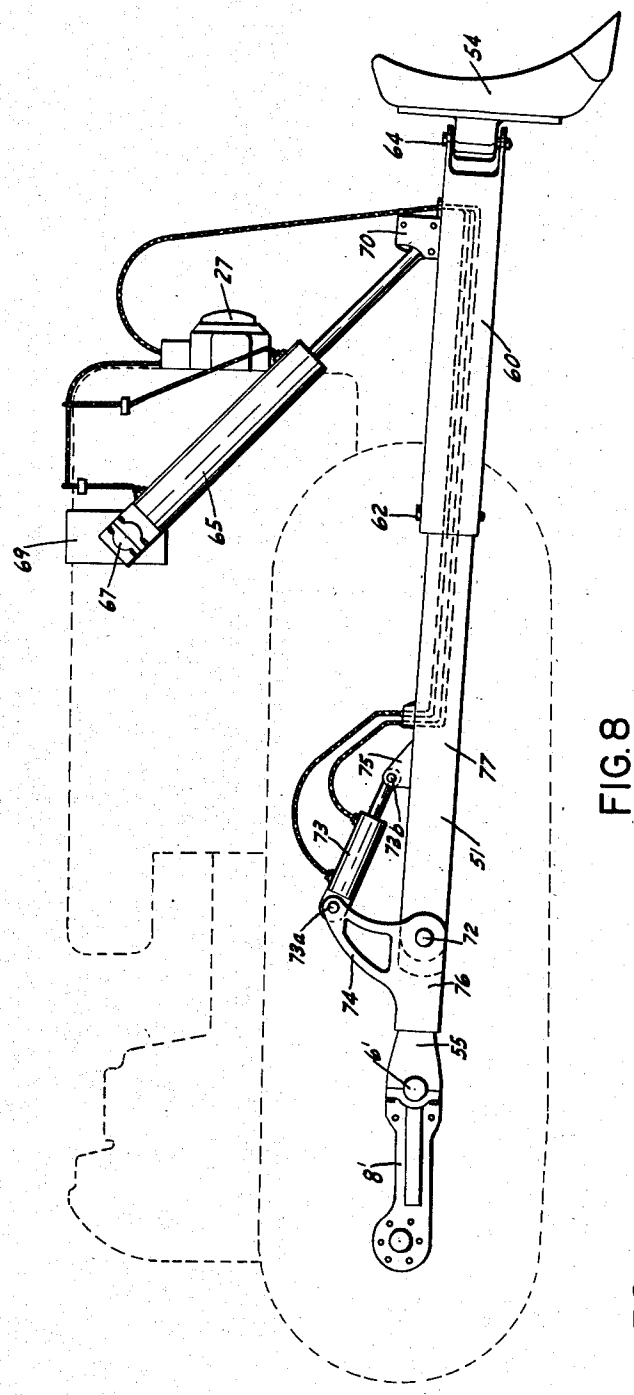


FIG. 8

GOTTFRIED REUTER,
LEO BARNES,
*INVENTORS.*

BY John Adams Thierry

ATTORNEY.

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ADJUSTABLE BULLDOZER

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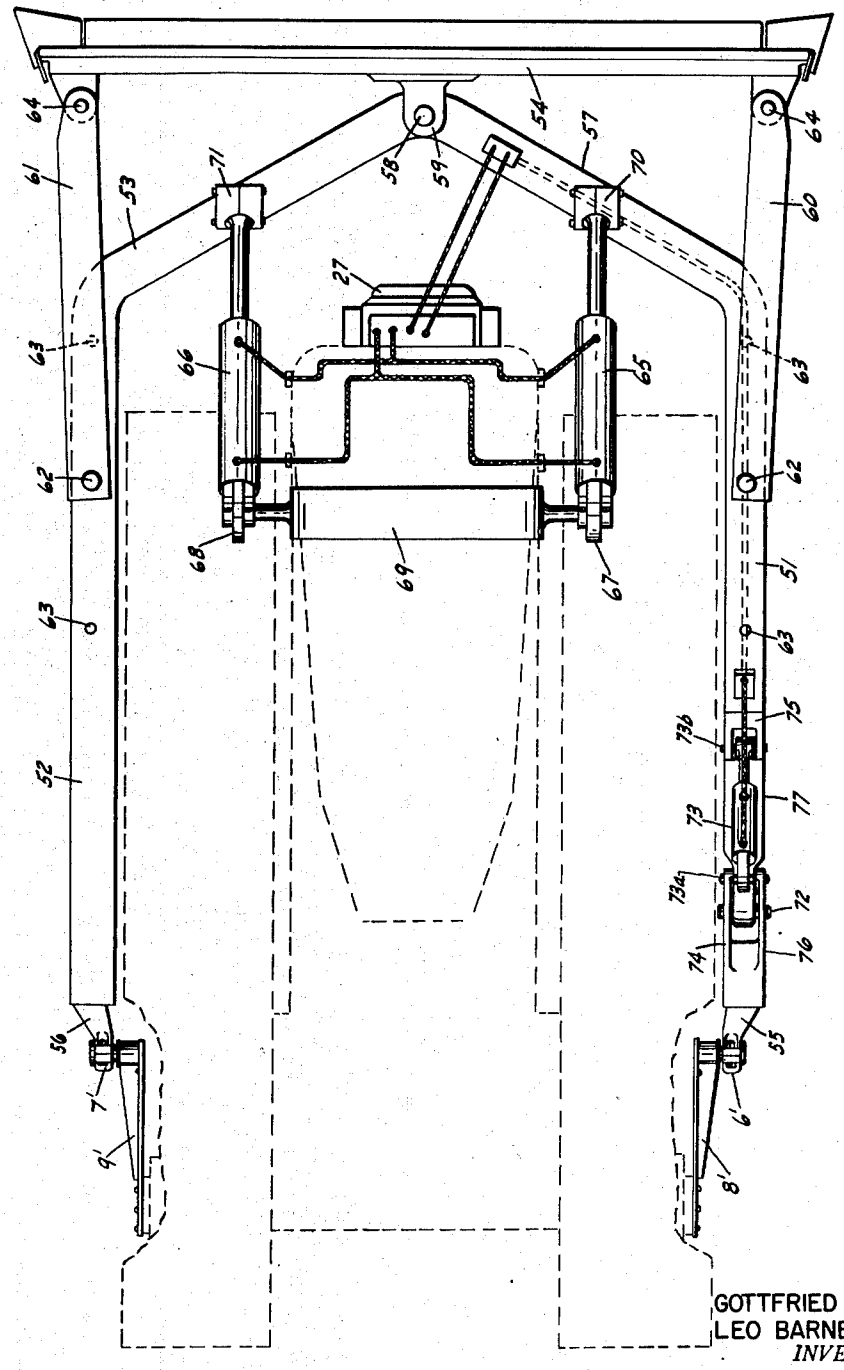


FIG. 9

GOTTFRIED REUTER,
LEO BARNES.
*INVENTORS.*

BY John Adams Thierry

ATTORNEY.

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ADJUSTABLE BULLDOZER

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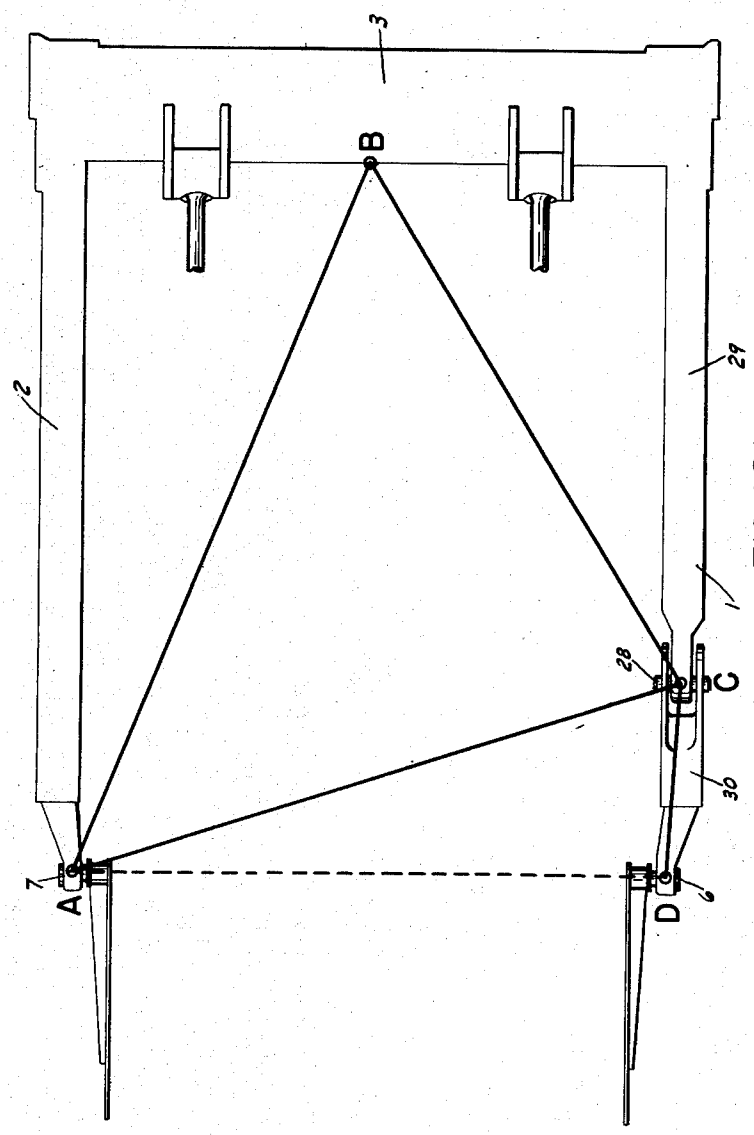


FIG. 10

GOTTFRIED REUTER,
LEO BARNES,
*INVENTORS.*

BY John Adams Thierry

ATTORNEY.

Patented May 18, 1954

2,678,508

# UNITED STATES PATENT OFFICE

2,678,508

## ADJUSTABLE BULLDOZER

Gottfried Reuter, South Milwaukee, and Leo Barnes, Cudahy, Wis., assignors to Bucyrus Erie Company, South Milwaukee, Wis., a corporation of Delaware

Application June 9, 1950, Serial No. 167,068

1 Claim. (Cl. 37—144)

1

Our invention relates to new and useful improvements in tractor-mounted bulldozers, more particularly to an improved means for effecting tilting of the bulldozer blade about a fore-and-aft axis.

In a bulldozer of the type to which our invention is more particularly adapted, a U-shaped frame surrounds the front end of a tractor, the rear ends of the two arms of the U being pivoted to the sides of the tractor, usually on or adjacent to the rear axle thereof, to permit raising and lowering movement about a transverse axis. The blade proper is mounted on the transverse base portion of the U. The manner of connecting the blade to the base of the U depends upon the type of bulldozer.

In the non-angling type of bulldozer, the blade is mounted rigidly on the transverse base portion of the U-shaped frame, and the U is generally rectangular in shape, so that the base of the U can be a cross beam that is integral with the back of the blade proper. The rigid connection between the back of the blade and the U-shaped frame is generally reinforced by braces that extend forwardly and upwardly in a vertical plane and inwardly in a horizontal plane from the forward ends of the arms of the U-shaped frame to the back of the blade.

In the angling type of bulldozer, the center of the back of the blade is mounted on the central portion of the transverse base of the U-shaped frame by means of a pivot joint which permits the blade to be angled in a horizontal plane. To allow for this angling, the base of the U-shaped frame is either curved or V-shaped with its apex at the connection to the blade. On each side of the U-frame an adjustable brace, called a "landside," extends from the side arm of the U to the adjacent end of the blade. The rear end of each landside can be attached to the adjacent side arm of the U-shaped frame at various positions to permit the blade to be angled in the horizontal plane and locked in selected angled positions.

A number of problems arise in the design of mechanisms to effect tilting of the blade about a fore-and-aft axis in the above-described two types of bulldozer.

In the non-angling type of bulldozer, tilting has been accomplished in the past by pivotally connecting the back of the blade to the forward end of the push arms and by providing an extensible and retractable upstanding brace between each push arm and the top of the blade. Tilting of the blade is then accomplished by retracting the brace on one push arm and at the same time extending the brace on the other push arm. (See for example U. S. Patent No. 2,452,774, issued November 2, 1948, to R. G. Le Tourneau.) This scheme, however, requires the use of three pivots between the blade, push arm, and adjustable brace just back of the blade where the connection to the push arm should be rigid. Furthermore it places the adjusting brace in an exposed position, and is not an arrangement that can be used on an angling as well as on a non-angling type of bulldozer.

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In the angling type of bulldozer, tilting of the blade has been accomplished in the past by employing a double swivel joint between the blade and central portion of the U-frame that will permit tilting about a fore-and-aft axis as well as angling about a vertical axis, and by providing a sliding connection between the forward end of each landside and the back of the blade along a circular track in a vertical plane. (See for example U. S. Patent No. 2,308,535, issued January 19, 1943, to T. R. Paulsen.) This scheme, however, makes it difficult to mount the blade compactly on the U-frame, requires tilting adjustment on both ends of the blade, and is not suitable for use on a non-angling type of bulldozer.

Accordingly the principal objects of our invention are to provide an improved mechanism for tilting the blade of a bulldozer, such that:

(1) The tilting mechanism is suitable for use on either a non-angling or angling type of bulldozer.

(2) Tilting of the blade can be effected by only a single adjustment on one side of the supporting U-frame.

(3) The tilt-adjusting mechanism is located in a protected position where it will not be exposed unduly to dirt and boulders that pile up and over or around the ends of the blade.

(4) The blade can be mounted compactly and securely upon the supporting U-frame with a minimum of pivotal connections thereto.

(5) The connection or connections between the blade and the supporting U-frame can be simple and rigid, to take the large stresses that occur at such connections.

(6) The blade and its supporting frame can be knocked down for shipment in a simple manner without sacrificing strength in the connection or connections between the blade and the arms of its supporting frame.

(7) The blade, its supporting U-frame, and the tilt-adjusting mechanism have a minimum

number of parts and are simple and inexpensive to manufacture, assemble, and disassemble.

In addition to the objects above stated, we have worked out a number of novel and useful details which will be readily evident as the description progresses. Our invention consists in the novel parts, and in the combination and arrangement thereof which are defined in the appended claim, and of which three embodiments are exemplified in the accompanying drawings, which are hereinafter particularly described and explained.

Throughout the description the same reference number is applied to the same member or to similar members.

Referring now to the accompanying drawings, it will be seen that:

Figure 1 is a side elevation of our improved non-angling type bulldozer, with the tractor indicated in outline only.

Figure 2 is a plan view of the bulldozer shown in Figure 1.

Figure 3 is a plan view, similar to Figure 2, but showing a second embodiment of our non-angling type bulldozer.

Figure 4 is an enlarged sectional view of the adjusting-screw and associated mechanism for tilting the blade, taken along the line 4—4 of Figure 3.

Figure 5 is an enlarged sectional view of the cylinder piston assembly and associated mechanism for tilting the blade, taken along the line 5—5 of Figure 2.

Figure 6 is an enlarged plan view, partly in section, of the coupling of the rear end of the right-hand push beam to its trunnion bracket on the right-hand side of the tractor, shown in Figures 2 and 3.

Figure 7 is an enlarged side view, partly in section, of said push-beam coupling taken along the line 7—7 of Figure 6.

Figure 8 is a side elevation of our angling type improved bulldozer, with the tractor indicated in outline only.

Figure 9 is a plan view of the bulldozer shown in Figure 8.

Figure 10 is a schematic plan view, similar to Figure 2, but showing in outline the non-angling bulldozer of our first embodiment, with a diagram superimposed to show the effective axes of rotation and the fixed and movable support points of the bulldozer assembly.

Referring now to Figures 1 and 2, we see that 1 and 2 represent a pair of transversely-spaced longitudinally-extending push beams which serve to mount the transverse blade 3 ahead of the tractor (shown in broken outline). The rear ends 4, 5 of push beams 1, 2 respectively are connected by suitable coupling means, such as ball-and-socket type universal joints 6, 7 (more fully described below) to trunnion brackets 8, 9 which are adapted to be rigidly secured to the outside of the track frames of the tractor.

The blade 3 is a built-up structure which generally includes a front moldboard 10, a longitudinal digging edge 11 adjacent the bottom of the moldboard, and side-plates 12 and 13 at the ends of the moldboard. The blade is reinforced by transverse angle irons 14 and 15 adjacent the top and bottom respectively of the back of the moldboard.

The forward ends of the push beams 1, 2 are rigidly connected, preferably welded, to the back of the blade 3 by a direct rigid connection to the respective ends of the angle iron 15 adjacent the bottom of the blade. Push beams 1, 2 and angle iron 15 thus constitute a rigid U-shaped supporting frame for the blade proper. This U-frame is braced at its forward corners by horizontal diagonal braces 16, 17 which project inwardly from the forward end of their respective push beams 1, 2 to the bottom angle iron 15 on the back of the blade. The blade is further braced to the push beams 1, 2 by upwardly and forwardly-inclined braces 18, 19 which are fixed at their rear end to a forward portion of their respective push beams and at their forward end to top angle iron 14 on the back of the blade. All braces are rigidly connected, preferably welded, to the blade and their respective push beams.

The bulldozer blade and its supporting frame are raised and lowered about the transverse pivot axis defined by universal joints 6 and 7 by conventional cylinder-piston assemblies 20, 21, which are mounted at one end by universal connections 22, 23 on mounting bracket 24 on the forward portion of the tractor, and are connected at their other end by universal connections 25, 26 to the top of the back of the blade. These cylinder-piston assemblies are inter-connected in order to provide an equalized effective central support for the blade in all tilt positions of the blade. Pressure fluid to operate the cylinder-piston assemblies 20, 21 is supplied from a conventional hydraulic unit 27 mounted at the front of the tractor. This hydraulic unit and the mechanism above described for raising and lowering the blade and its U-frame are conventional and form no part of our invention.

The bulldozer blade is tilted about a central fore-and-aft axis by the following-described mechanism, to which our invention is directed.

Intermediate the ends of push beam 1 we have coupling means in the form of a transverse pivot joint 28 which permits the forward and rearward segments 29 and 30 respectively of the push beam to pivot relative to each other about a transverse axis. In the claim, segments 29 and 30 are for simplicity called "side arm" and "side members" respectively.

Such relative pivoting of segments 29 and 30 about pivot 28 is effected by an extensible and retractable means, such as a double-acting cylinder-piston assembly 31, which is pivotally connected at one end 31*a* to an upstanding bracket 32 on rear segment 30 and at the end 31*b* to lugs 33 on forward segment 29 of push beam 1. Cylinder-piston assembly 31 is actuated by pressure fluid from hydraulic unit 27. The details of this hydraulic unit and its various control valves for governing the supply of pressure fluid alternatively to cylinder-piston assemblies 20, 21 (to raise or lower the blade) or to cylinder-piston assembly 31 (to tilt the blade) form no part of our invention.

It will be seen that when cylinder-piston assembly 31 is in its normal mid position the two segments 29, 30 of push beam 1 are in longitudinal alignment (or toggle) and the two push beams 1, 2 are effectively parallel to each other, so that the blade is in its normal level position. If the cylinder-piston assembly is now retracted, pivot 28 will move downwardly out of its normal toggle position, causing the end of the blade adjacent push beam 1 to tilt downwardly about the fore-and-aft central axis of the tractor. If the cylinder-piston assembly 31 is extended from its mid position, pivot 28 will move upwardly from its normal toggle position, causing the adjacent end of the blade to tilt upwardly. In other words the blade is tilted whenever the rear

segment 30 is swung about pivot 28 so that segments 29 and 30 are no longer in alignment and the axes of push beams 1 and 2 are no longer parallel.

This method of tilting the blade has the advantage not only that it is accomplished by merely a single adjusting cylinder-piston assembly, but also that it eliminates the need of any pivotal connections between the blade and the forward ends of the push beams and bracing where stresses are high. Furthermore the tilt-adjusting cylinder can be located well back of the blade and on only one side of the tractor.

Figures 3 and 4 show, as an alternative embodiment, a screw-type jack 34 substituted for cylinder-piston assembly 31 on push beam 1 of a non-angling bulldozer in which the blade and its supporting frame is raised and lowered by a conventional winch 36 (shown in broken outline) and cable 37, instead of being raised and lowered hydraulically. A second similarly-mounted screw jack 35 is shown also on push beam 2' which is jointed in the same manner as push beam 1, so that, when both the screw jacks are retracted (or extended) the same amount, the blade is tipped rearwardly (or forwardly) about the transverse axis of the pivot joints. If only one screw jack is operated the blade is merely tilted about a fore-and-aft axis.

Figures 6 and 7 show details of the ball-and-socket type universal joint used in the embodiments of Figures 1 to 4 to connect the rear ends of push beams 1 and 2 to the trunnion brackets 8 and 9 respectively. The right-hand universal joint 6 on push beam 1 is shown, the universal joint 7 being of the same construction except for opposite orientation. The rear end 4 of right-hand push beam 1 has a split collar consisting of semi-circular members 38, 39 which are secured together by bolts 40 and register with spherical collar 41 which in turn is rotatably and slidably mounted on trunnion 42 of trunnion bracket 8 at the side of the tractor. Spherical collar 41 is somewhat wider (along the axis of trunnion 42) than split collar 38—39, to permit limited rotation of push beam 1 about its longitudinal axis when the blade is tilted. Likewise trunnion 42 allows limited axial movement (as well as unlimited rotation) of spherical collar 41 so that the rear end of the push beam can shift outwardly when the blade is tilted.

Push beam 2, in the embodiment of Figures 1 and 2, has, just back of the rear end of its vertical brace 19, a rigid bolted butt joint 43. This permits the blade 3 and the forward portions of the push beams 1 and 2, to which the blade is rigidly connected, to be shipped as a unit, the rear portions of the push beams being easily disassembled from such unit at butt joint 43 and pivots 28 and 31*a*. In the embodiments of Figures 3 and 4, no butt joint is required, since there is a detachable pivot joint on each of the push beams.

Figures 8 and 9 show our invention applied to an angling-type hydraulic-operated bulldozer, in which 51 and 52 represent the transversely-spaced longitudinally-extending side arms of a U-shaped bulldozer supporting frame 53, the front transverse portion 57 of which serves to mount the bulldozer blade 54 forwardly of a tractor (shown in dotted outline). The rear ends 55, 56 of side arms 51, 52 respectively are connected, as in our first embodiment, by means of ball-and-socket type universal joints 6', 7' to trunnion brackets 8', 9' which are adapted to be rigidly



secured to the outside of the track frames of the tractor.

Blade 54 is disposed transversely of the frame 53 in advance of the front portion 57 of the U-frame. It is mounted to be swung in a normally-horizontal plane about the axis of the kingpin 58 which extends vertically through rearwardly projecting spaced lugs 59 on the back of the blade 54. Accordingly the blade 54 may be swung in a horizontal plane into selected positions with respect to the longitudinal axis of the frame 53.

In order to retain the blade 54 in a given position in the horizontal plane, channel-retaining bars 60, 61, known as "landsides," are provided between the side arms 51, 52 respectively and the ends of the blade 54. The rear end of each landside carries a pin 62 which is receivable in one of holes 63 longitudinally spaced along each side arm of the frame 53. The forward end of each of the landsides 60, 61 is pivotally connected by a vertical pin 64 to the back of the blade 54 at each end thereof. This permits swinging each landside about the vertical axis of its pin 64 when the blade 54 is moved into any selected angled position.

The bulldozer blade 54 and its supporting U-frame 53 are raised and lowered about the transverse axis defined by universal joints 6' and 7' by conventional cylinder-piston assemblies 65, 66, which are mounted at one end by universal connections 67, 68 on mounting bracket 69 on the forward portion of the tractor, and are connected at their other end by universal connections 70, 71 to the forward transverse portion 57 of U-frame 53. Pressure fluid to operate the cylinder-piston assemblies 65, 66 is supplied from a conventional hydraulic unit 27 mounted at the front of the tractor, as in our first embodiment.

The bulldozer blade 54 is tilted about a fore-and-aft axis by a mechanism which is similar to that described in our first embodiment, except that the transverse pivot joint 72 in side arm 51, and the double-acting cylinder-piston assembly 73, which is pivotally connected at its ends 73*a* and 73*b* to brackets 74, 75 on the segments 76, 77 respectively rearwardly and forwardly of pivot joint 72, are now located closer to the rear end 55 of push arm 51, in order to provide space on said arm 51 for sliding the rear end of landside 60 along the side arm when the blade 54 is angled. Cylinder-piston assembly 73 is actuated by pressure fluid from hydraulic unit 27, as in our first embodiment.

Tilting of the blade 54 is accomplished by retracting and extending cylinder-piston assembly 73 in the same manner as in our first embodiment, blade 54 being constrained by king pin 58 and landsides 60, 61 to tilt with the forward transverse portion 57 of the U-frame 53 about the fore-and-aft central axis of the U-frame.

This method of tilting the blade of an angling type bulldozer has not only the advantages of our first embodiment that tilting is accomplished by a single adjusting cylinder-piston assembly and that this cylinder can be located well back of the blade on one side of the tractor, but also has the advantage that a simple vertical pivot connection, instead of a cumbersome double-swivel or universal connection, can be used to mount the center of the blade compactly on the U-frame, so that the blade will be as close as possible to the front of the tractor. Furthermore this method of tilting the blade permits us to employ a simple pivot connection between the ends of the blade and the forward ends of the land-

sides, thus eliminating the cumbersome dirt-collecting interlocking track members formerly used.

Turning now to Figure 10, this shows a schematic plan view of our first embodiment (non-angling bulldozer with single tilt-actuating cylinder) on which a diagram in heavy lines has been superimposed to show the character of the tilting movement obtained when pivot 28 is raised and lowered by the tilting cylinder (not shown). It will be seen that the bulldozer assembly consists of (1) rear push-beam segment 30 and (2) a rigid frame comprising a push beam 2, blade 3, and front push-beam segment 29. Rear push-beam segment 30 is supported at its rear end by universal joint 6 at point D on fixed axis AD on the tractor, and at its front end by pivot joint 28 at movable point C. The rigid frame, consisting of the blade 3 and push-beam members 2 and 29, is supported by the tractor at point A (at left rear universal joint 7) on fixed axis AD and at fixed point B (at center of blade which is the effective point of support by cylinders 20, 21, since these cylinders are interconnected to provide an equalized support for any tilted position of the blade), and by movable point C (at movable pivot joint 28).

Since for any tilting motion points A, B, and D remain in the same plane, it will be seen that, when point C is raised or lowered with respect to that plane, the blade 3, with its rigid members 2 and 29, will tilt about a fore-and-aft skew axis AB which is fixed in said plane (except for its negligible clockwise swinging motion in said plane due to the slight reduction in the effective length of push beam 1). When this tilting motion occurs, the front end of segment 30 at C moves in an arc substantially about the fixed transverse axis AD (except for the negligible inward swinging motion of point C due to the tilting about skew axis AB).

The motion of each push beam can be resolved into three rotations:

(1) Rocking up and down about axis AD.

(2) Lateral rocking about the effective longitudinal axis of the push beam.

(3) A slight swinging about the vertical axis through its rear support, at A or B as the case may be, this swinging being negligible when the angle of tilt is small.

When a single tilt cylinder is employed (as in our first embodiment), the character of these three rotations will be the same for each push beam but the two push beams will not rotate exactly the same amount, due to the skew tilt axis and lack of symmetry. When, however, two tilt cylinders (or other means) are employed, one on each push beam (as in our second embodiment), and these tilt-actuating cylinders are actuated an equal amount in opposite directions, the tilt axis will be the central longitudinal axis of the tractor, and the push beams will rotate the same amount, since they are disposed symmetrically about the tilt axis.



The above description of the tilting motion of our non-angling bulldozer is equally applicable to the angling bulldozer of our third embodiment.

Having now described and illustrated three forms of our invention, we wish it to be understood that our invention is not to be limited to the specific form or arrangement of parts herein described and shown.

We claim:

In a bulldozer, the combination of: a rigid U-shaped blade-supporting frame adapted to embrace the forward end and sides of a tractor and comprising a forward transverse portion and a pair of side arms integral therewith and extending rearwardly therefrom; a blade supported by the forward transverse portion of said frame; first coupling means adapted to couple the rear end of one of said side arms to one side of the tractor for raising and lowering movement about a transverse axis and rocking movement about the longitudinal axis of said side arm; a longitudinal side member; second coupling means on said side member adapted to couple the rear end of said side member to the other side of the tractor for raising and lowering movement about said transverse axis; third coupling means located forwardly of and adjacent the second coupling means on said side member and coupling said side member to the rear end of the other of said side arms for pivotal movement about a second transverse axis; at least one of said first, second and third coupling means being also adapted to permit limited relative sliding transverse movement of its coupled parts, and at least one of said second and third coupling means being adapted to permit relative lateral rocking movement of its coupled parts about a longitudinal axis through the coupling; said side member and said other side arm being normally in longitudinal alignment; and extensible and retractible means operatively connected to said side member and said other side arm to effect relative pivotal movement of said side member and said other side arm and thereby tilt the blade about a generally fore-and-aft skew axis.


**References Cited** in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,173,158 | Corbett | Sept. 19, 1939 |
| 2,238,346 | Sorensen | Apr. 15, 1941 |
| 2,408,268 | Peterson et al. | Sept. 24, 1946 |
| 2,429,506 | Austin | Oct. 21, 1947 |
| 2,452,774 | Le Tourneau | Nov. 2, 1948 |
| 2,485,407 | Peterson | Oct. 18, 1949 |
| 2,529,124 | Austin | Nov. 7, 1950 |