July 1, 1969 J. M. DELI 3,452,828

BULLDOZER TILTABLE BLADE MOUNTING

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FIG. 1.

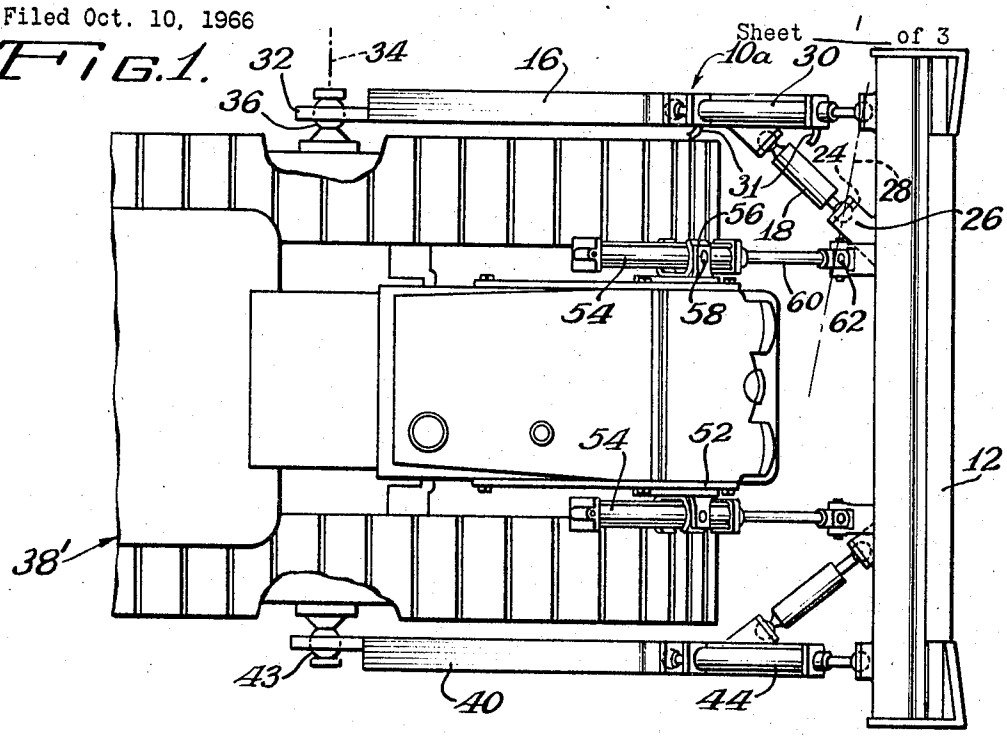


FIG. 2.

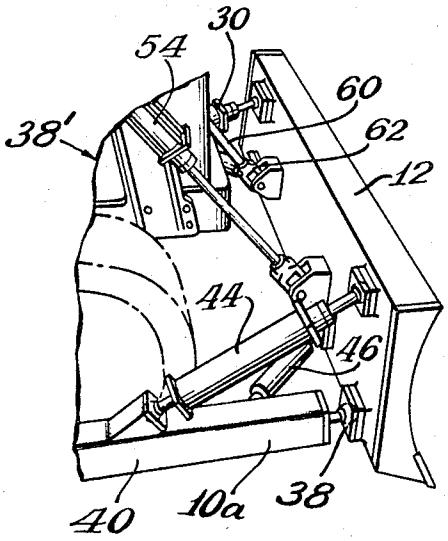
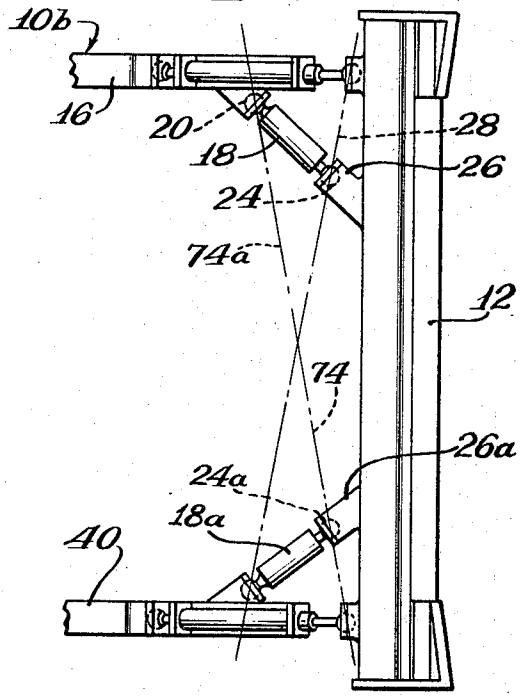


FIG. 7.



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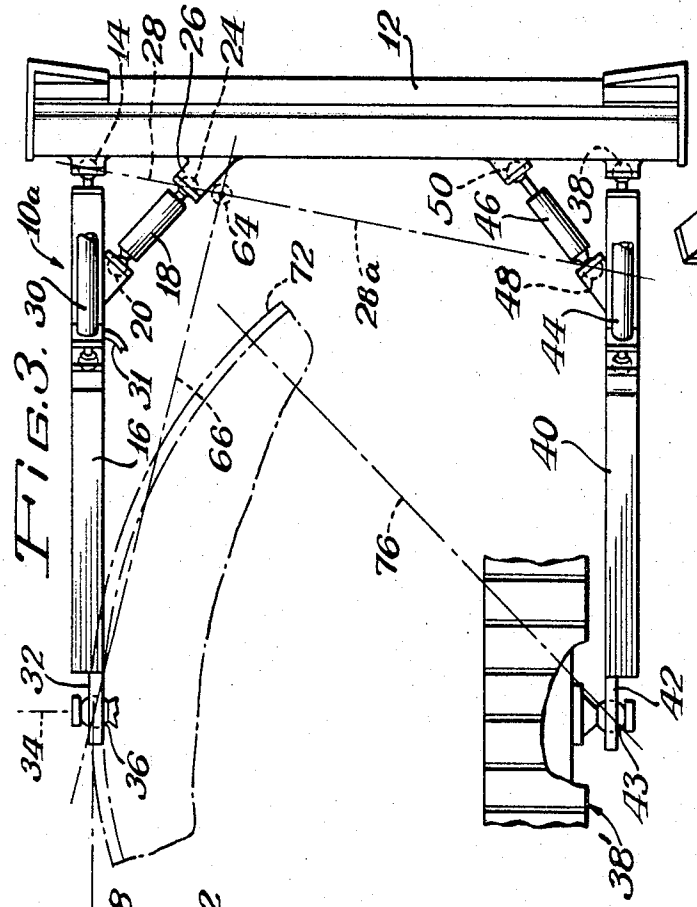


FIG. 3.

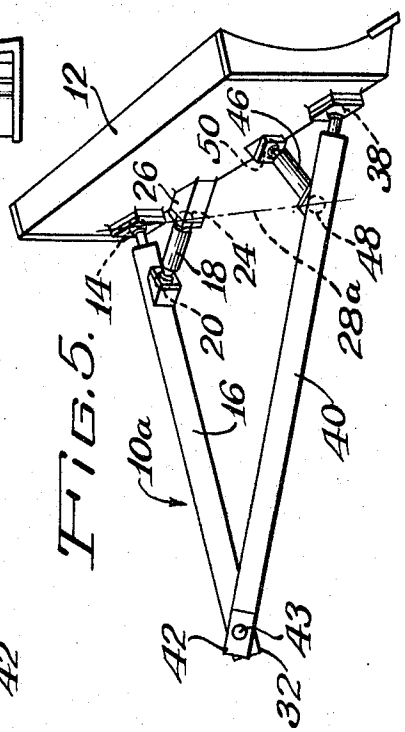


FIG. 5.

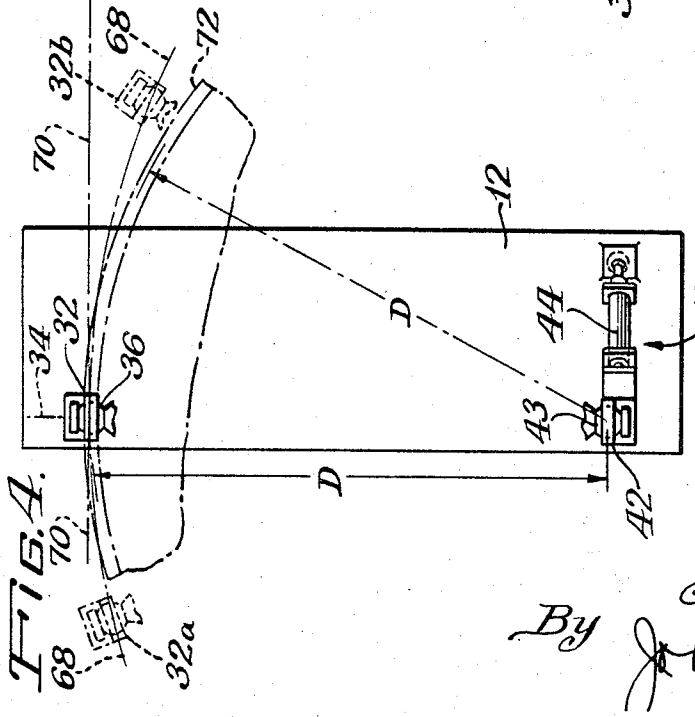


FIG. 4.

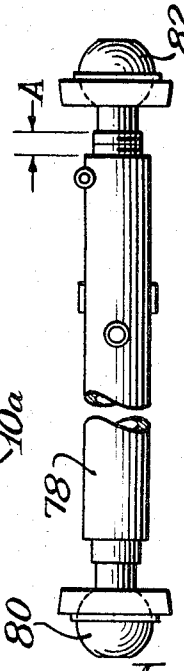


FIG. 6.

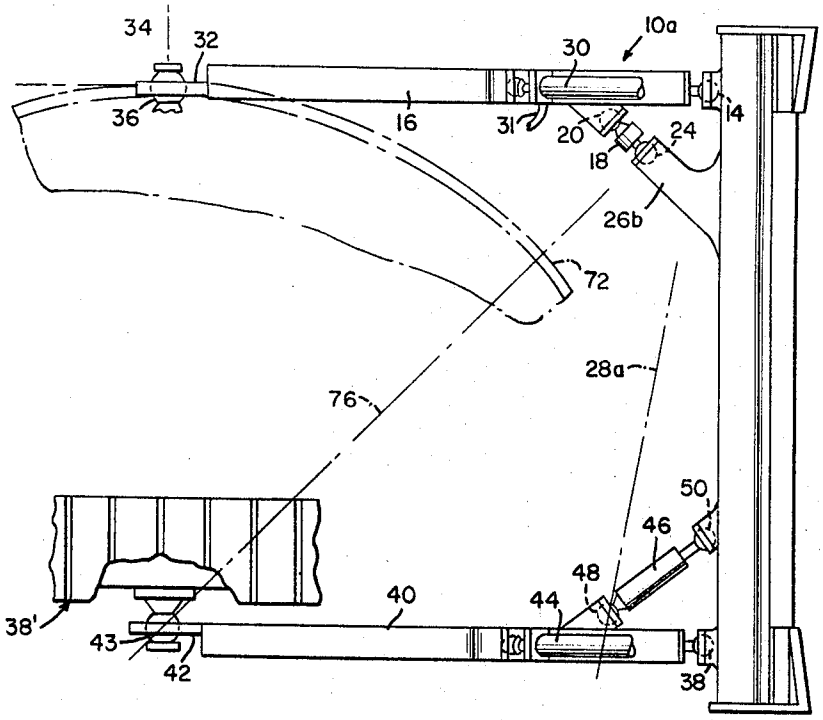
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BULLDOZER TILTABLE BLADE MOUNTING

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FIG. 8



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3,452,828

BULLDOZER TILTABLE BLADE MOUNTING

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Int. Cl. E02f 3/76
U.S. Cl. 172—803 10 Claims

ABSTRACT OF THE DISCLOSURE

Bulldozer blade attachment for bulldozers having proper geometry for tilting the blade without setting up undue stresses in the attachment. The customary diagonal braces, providing lateral stability at each side of the blade between it and a blade connected push arm at that side, are placed with a geometry such that the brace-to-blade connection is both medially and rearwardly offset from the push arm-to-blade connection on at least one side of the bulldozer. The general tendency of the push arms to elastically bow outwardly during blade tilt is substantially eliminated with this geometry.

This application relates to a tiltable bulldozer blade and a mounting therefor. It more particularly relates to means for so mounting the blade on a bulldozer as to prevent damage from stresses that set up in the mounting means when the blade is moved into tilted position on the bulldozer.

In the drawings:

FIGURE 1 is a top plan view of a tractor bulldozer embodying a preferred form of my invention;

FIGURE 2 is an isometric showing of the bulldozer blade mounting means, as viewed from the right side of the tractor;

FIGURES 3 and 4 are schematic showings consisting of top plan and rear elevational views of the mounting means;

FIGURE 5 is an isometric view similar to FIGURE 2, but showing the mounting means in a changed position and with certain parts removed for simplification;

FIGURE 6 is a showing of a strut, in side elevation;

FIGURE 7 is a view similar to FIGURE 3, but showing a modification; and

FIGURE 8 is a view similar to FIGURE 3, and illustrating schematically the location of axes of swinging.

In a bulldozer tiltable blade mounting having an offset brace connection to the blade so as to embody the improved geometry according to my invention, and having a frame more particularly indicated at **10***a* in the accompanying drawings, the bending forces normally attendant with tilting of the mounted blade **12** are materially reduced in the mounting frame or substantially eliminated therefrom.

By tilting, in its simplest form, I mean for example the downward angling, about a first point of interconnection **14**, of a push arm structure **16** at a first side of the mounting frame **10** relative to the side of the blade structure at that side. In absolute terms, the blade structure actually rises at that side (FIGURE 5) and so does the push arm structure because of the blade articulation **14** thereto, whereas the blade structure at the other side can stay poised at the previous elevation. A diagonal frame brace **18** on the first side, having an articulation **20** connecting it at one end to the adjacent push arm structure **16**, provides at its forward end a rearwardly offset second point of connection **24** of the mounting frame to the blade structure at that side. Providing offset to the second point of connection is believed novel, and is actually made at the projecting end of an offset back bracket **26** rigidly secured to the blade structure.

The first and second points of connection **14** and **24** thus establish a diagonal axis **28** of relative swinging between the tilting blade and push arm structures, minimizing the bending forces tending to place the brace **18** in unwanted compression and consequently tending to bow the push arm structure **16** outwardly. One case where tilting is of particular advantage occurs when power means, such as a tilt cylinder **30** which extends upwardly as a tilt strut between the top of the push arm structure **16** and the blade structure, is provided so that while the vehicle is on the go the blade can be moved into a tilted position relative to the vehicle. In that manner, the vehicle can be readily turned when the blade is working simply by raising the blade at one end, so that the vehicle in ramping itself out of the cut inherently turns as it goes. The rest of the power means is not shown, and includes simply a conventional source of hydraulic high and low pressure on the vehicle, raise-lower-hold tilt valving, and hydraulic hoses **31** and lines having the tilt valving included therein and connected thereby between the high and low pressure source and the tilt cylinder **30**.

The push arm structure **16** extends rearwardly from the blade structure **12** and has a trunnion end portion **32** mounted for swinging on an axis **34** upon a trunnion **36** fixed to the side of the vehicle **38'**.

Except for the offset of the back bracket **26** and the diagonality of the axis **28**, the mounting frame **10***a* is essentially symmetrical. More particularly, the blade structure **12** has a separate articulation **38** to the other push arm **40**, the other push arm being arranged to extend longitudinally rearwardly therefrom and is connected by a trunnion portion **42** of such other arm to a fixed trunnion **43** on the vehicle. A tilt strut **44** in the mounting frame extends upwardly between the top of the other push arm **40** and the blade structure **12**. A diagonal brace **46** which extends from the medial surface of the other push arm **40** to the blade structure, has a brace articulation **48** connecting it to the push arm and provides at the front end another point of connection **50** of the mounting frame to the blade structure **12**.

Means is provided for raising and lowering the mounting frame and blade structure **12**, and includes an appropriate lift frame **52** (FIGURE 1) carried by the vehicle **38** for that purpose.

Illustrative of one raising and lowering means is a pair of identical hoist cylinders **54**, the one adjacent the first side of the vehicle being the only one described, in the interests of brevity. A yoke **56** is journaled in one end of the gimbal tube, not shown, carried by the lift frame **52**. The yoke **56** supports the cylinder **54** for universal movement and includes a gimbal cap **58** in the connection to the cylinder **54**.

Although hoist cables are equally adapted to raise and lower the blade **12**, a piston rod **60** extending from the cylinder **54** is illustrated as the power means connected to the blade **12**. A universal joint **62** interconnects the rod **60** and the blade to prevent binding.

For purposes of analyzing the geometry of the frame **10** in operation, the frame may be considered a free body. Swinging of the push arm structure **16** caused by extending the cylinder **30** so that it lengthens in its function as a tilt strut, causes the trunnion end **32** to swing about a center **64** in a plane **66** as viewed in FIGURE 3, and to follow an elliptical locus **68** so as to take the position shown by the dotted line **32***a* in FIGURE 4.

So instead of following the customary locus of points which would appear as the straight line **70** in FIGURE 4, the actual locus **68** according to my improvement, more nearly falls upon the surface of a reference sphere **72** representing all points in space that maintain a constant distance D from the trunnion end **42** of the other push arm. Obviously, if the trunnion end **32** always tries to

maintain a constant distance D at all points from the trunnion end **42**, then the ends will readily and inherently conform to the fixed spacing D between the trunnions **36** and **43** fixed to the vehicle.

The blade structure **12** is tilted in the opposite direction by retracting the cylinder **30** to shorten the effective strut length thereof. In that case, the free body position of the trunnion end of the push arm structure **16** takes the dotted line position **32***b*, FIGURE 4, in which again it falls closely adjacent to the surface of the reference sphere **72**. So the push arms at the side of the vehicle are subjected to minimum bending forces and hence to minimal outward bowing. As illustrated (FIGURE 3), the axis **28** is coincident with a line **28***a* intersecting the other push arm **40** such that, as measured from the point of blade articulation **38**, the distance to the point of intersection is no less than the distance between the articulation **38** and the point of brace articulation **48** to the other beam **40**. The line **28***a* is actually shown passing adjacent the articulation **48** which connects the diagonal brace **46** and the other push arm **40**.

If the hydraulic cylinder **30** is extended so as to increase its length as a tilt strut, at the same time at which the tilt strut **44** on the other push arm **40** is foreshortened so as to decrease its tilt strut length, a greater angle of blade tilt out of a horizontal plane is achieved. The result, in its basic geometry, is illustrated in FIGURE 5, whereas the opposite tilt result is produced if the tilt cylinder **30** is shortened and the tilt strut **44** is lengthened.

If the tilt strut **44** is an hydraulic cylinder, then operating it in opposite direction from the tilt cylinder **30** produces on-the-go tilting to the greater degree mentioned, without the need for the driver to stop the vehicle **38** and make a tilt strut adjustment on the ground.

Making the mounting frame symmetrical as illustrated at **10***b* in FIGURE 7, enables the frame to take the position of FIGURE 5 with even further reduction in the bending stresses, the importance of which is apparent. The illustrated embodiment has the simple modification of a back bracket **26***a* which is like the bracket **26**. The back bracket **26***a* effects a ball connection **24***a* between the rearwardly projecting end thereof and the diagonal brace **46***a* which is articulated to the other beam **40**.

The two points established by the ball connection **24***a* of the diagonal brace **18***a* and the blade articulation **38** (not shown) to the other beam **40** define an axis **74** of relative swinging between the blade structure **12** and the other push arm **40**. Such axis **74**, when extended, coincides with a line **74***a* intersecting the push arm structure **16** adjacent the articulation **20** connecting the diagonal brace **18** and the push arm structure **16**.

The difference, in sum, is that the FIGURE 5 embodiment has only one swing axis **28** which extends diagonally between the push arms, whereas the FIGURE 7 embodiment has swing axes **28** and **74** both of which extend diagonally between the push arms.

All joints, connections, and articulations illustrated are either ball joints or their equivalent, such as the universal joint **62**, FIGURE 1. It is evident that, at some of the points of juncture, a pin joint or other type joint can readily be substituted.

In FIGURE 6, an extensibly and foreshortenably adjustable link **78** is illustrated, to show the typical balls **80** and **82** in the ball joints thereof. At the point of adjustment, the dimension A can be changed by manipulating the link **78**, thereby lengthening or shortening the center-to-center distance between the balls **80** and **82**.

The link **78** is standard for braces such as the diagonal braces **18** and **46** and for the strut **30** or the strut **44** or both, if hydraulic tilt cylinders are not used as the tilt struts.

Pitching is accomplished by tipping the blade structure **12** about the transverse axis defined by the blade articulations **14** and **38** (FIGURE 3) to the push arms. A frontward pitch so as to tilt the blade forwardly increases the so-called suction angle for ease in handling hard material. A decreased suction angle is employed for soft material.

Decreasing or increasing the suction angle of the blade **12** shown in FIGURE 3 requires lengthening of the diagonal brace **18**, but no change in the diagonal brace **46**. The reason is that the joint **50** coincides with the pitch axis just described whereas the second point of connection **24** is horizontally rearwardly offset therefrom so as to fall on the diagonal axis **28**. Both diagonal braces **18** and **46***a* require lengthening in the mounting frame **10***b* shown in FIGURE 7, when pitching the blade **12**.

Ideally, provided the diagonality of the axis **28**, for example, is increased to where it coincides with a line **76** (FIGURE 3) passing through the trunnion end **42** of the other push arm **40**, the trunnion end **32** will in relative terms be caused to swing in a locus of points each on the surface of the reference sphere **72** so as to stay at all times precisely equidistant from the trunnion end **42** of the other push arm. As a result in the vehicle **38'**, all tilt-caused bending stresses can therefore be eliminated from the two push arms associated in the blade mounting structure.

However the ideal, as actually illustrated in FIGURE 8, is sometimes difficult to achieve as a practical matter because an exaggerated offset of the bracket **26***b* as seen to be required in FIGURE 8 complicates the interconnecting structure and complicates the geometry somewhat for other aspects of blade handling.

The blade structure is a bulldozer blade, a bullgrader blade, or other earth working blade depending upon the material being displaced. It is apparent from the foregoing that the blade, in its various positions of angularity of elevation, tilt, and pitch, is readily positioned by the mounting frames hereof and conforms to the fixed distance D maintained between the trunnions **36** and **43**. In other words, the push arms do not bend unduly despite their noted general tendency at the trunnion ends **32** and **42** to spread apart.

Variations within the spirit and scope of the invention described are equally comprehended by the foregoing description.

What is claimed is:

1. In the mounting for a transversely disposed earth working blade structure which comprises individual push arms, said structure having a separate articulation to each push arm, said push arms arranged to extend longitudinally rearwardly therefrom to trunnion portions of the arms and with one push arm structure disposed at a first side and the other arm at the other side of the mounting, tilt struts extending upwardly between the tops of the push arms and the blade structure, diagonal braces extending from the medial surfaces of the push arms to the blade structure, first adjusting means (**30**) at at least the first side of the mounting to adjust the length of the tilt strut at that side to effect tilting of the blade structure, means of brace articulation connecting the diagonal braces to the respective push arm structure and other push arm, said blade articulation to the push arm structure constituting a first point of connection of the mounting to the blade structure at the first side and the diagonal brace at that side providing a second point of connection of the mounting to the blade structure at the first side:

the improvement wherein the first and second said points of connection establish an axis of relative swinging between the blade and push arm structure which extends diagonally between the push arms and which, when extended, substantially coincides with a line (**28***a*) intersecting the other push arm at a point such that the distance between the just said point of intersection and the point of blade articulation to said other push arm is no less than approximately the distance between the respective points of blade articulation (**38**) and brace articulation (**48**) to said other push arm.

2. The invention of claim 1, characterized by:
means at one side of the mounting to adjust (A) the effective link length of at least the diagonal brace at that side to accommodate pitching of the blade structure.

3. The invention of claim 1, characterized by:
means (18) at at least the first side of the mounting to adjust (A) the length of the diagonal brace at that side to accommodate pitching of the blade structure.

4. The invention of claim 1, characterized by:
the second point of connection being formed between the rearwardly projecting end of an offset, back bracket (26) on the blade structure and the forward and medially extending end of the adjacent diagonal brace.

5. The invention of claim 1:
the swing axis characterized, when extended, by passing at least closely adjacent the trunnion portion (42) of the other push arm.

6. The invention of claim 1:
a plurality of the points of articulation and connection characterized by ball joints.

7. The invention of claim 1, characterized by:
supported hoist means having means of connection to a support and having means of connection to the mounting for causing lifting and lowering movement;
a plurality of the points of articulation and connection consisting of ball joints and universal joints.

8. The invention of claim 1 including:
a bulldozer having fixed trunnions and swingably carrying said mounting thereon, the blade structure comprising a bulldozer blade which tilts on the mounting, the described improvement effective to reduce stresses set up in the mounting upon such tilting.

9. The invention of claim 1, characterized by:
the first adjusting means comprising an hydraulic cylinder 30 forming the tilt strut at the first side, and further comprising means for extensibly and foreshortenably moving the hydraulic cylinder to change the effective link length of the tilt strut.

10. The invention of claim 4, characterized by:
a back bracket (26*a*) on the blade structure effecting a ball connection between the rearwardly projecting end thereof and the diagonal brace which is articulated to the other beam;
the ball connection of the just said diagonal brace and the blade articulation to the other push arm constituting two points establishing the axis of relative swinging between the blade structure and the other push arm, which axis when extended substantially coinciding with a line (74*a*) intersecting the push arm structure at a point such that the distance between the just said point of intersection and said first point of connection is no less than approximately the distance between the respective first point of connection (14) and the point (20) where the adjacent diagonal brace has brace articulation to the push arm structure.

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