March 30, 1965 D. S. STRADER 3,175,315

ADJUSTABLE BULLDOZER BLADE MOUNTING

Filed Aug. 23, 1962 3 Sheets-Sheet 1

Fig. 1.

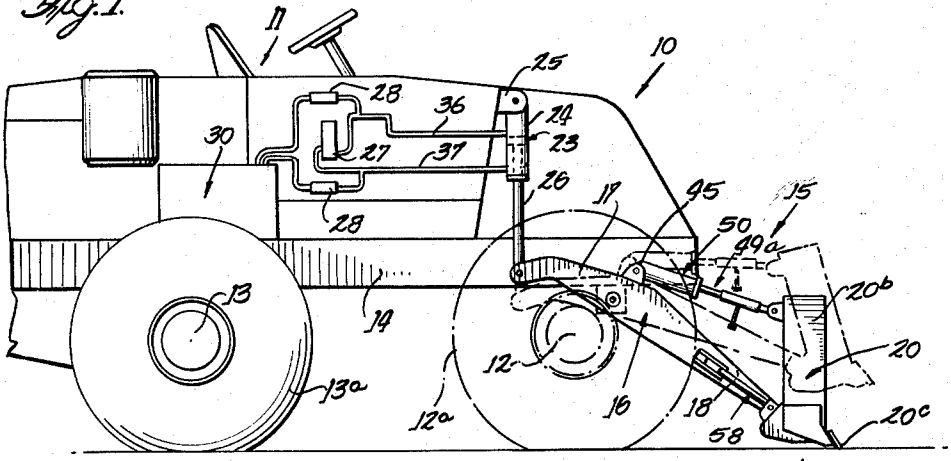
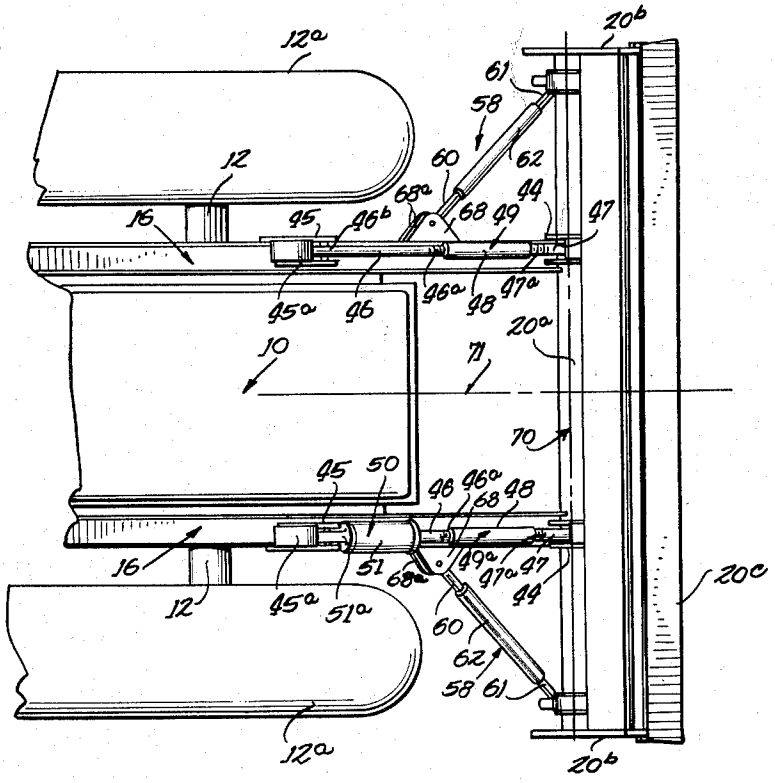


Fig. 2.



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ADJUSTABLE BULLDOZER BLADE MOUNTING

Filed Aug. 23, 1962 3 Sheets-Sheet 2

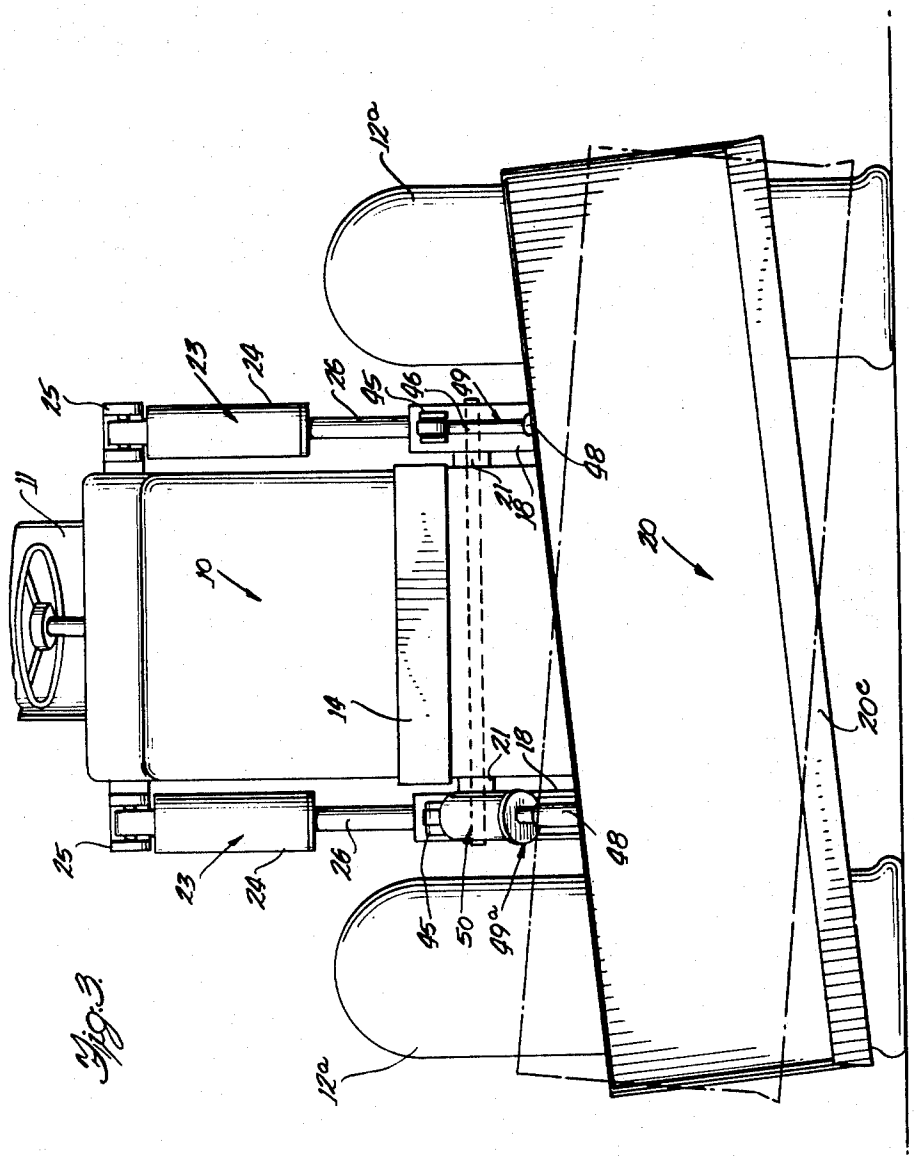


Fig. 3

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ADJUSTABLE BULLDOZER BLADE MOUNTING

Filed Aug. 23, 1962 3 Sheets-Sheet 3

Fig. 4.

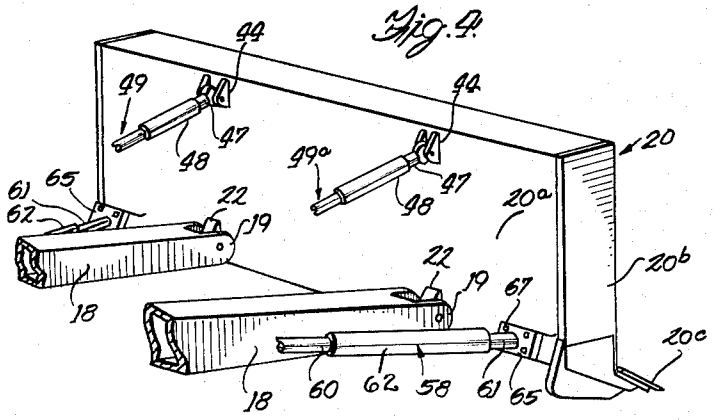


Fig. 5.

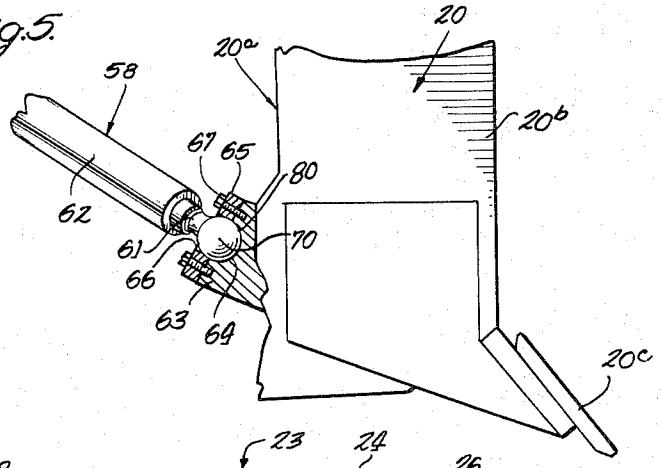
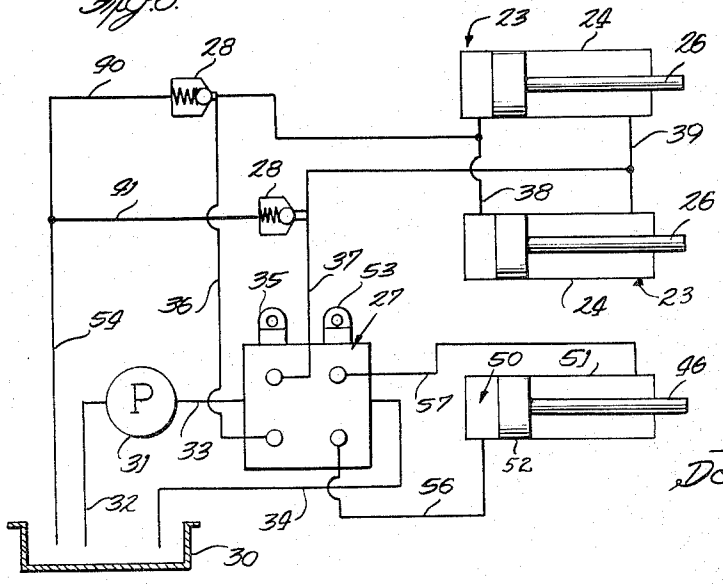


Fig. 6.



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3,175,315

ADJUSTABLE BULLDOZER BLADE MOUNTING

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Filed Aug. 23, 1962, Ser. No. 218,935
2 Claims. (Cl. 37—144)

This invention relates to an adjustable bulldozer arrangement for a tractor and more particularly to a bulldozer arrangement that can be separately adjusted about the transverse and longitudinal axes of the tractor and wherein the bulldozer blade is supported by a novel supporting means that permits relative adjustment between the novel supporting means during one of the separate adjustments of the bulldozer arrangement thereby reducing reactionary forces or stresses. Further, the supporting means provides an arrangement that is novel to change the elevation of the bulldozer blade relative to ground level and also provides substantial absorption of loading forces that may be transmitted through the supporting means.

One of the objects of the present invention is to provide a pair of novel supporting arms pivotally connected intermediate the ends thereof to the tractor and having one of the outer ends of each of the supporting arms connected to a hydraulic ram or actuator and the other outer ends of each of the arms connected to the bulldozer blade. Upon selective actuation of the hydraulic ram the elevation of the bulldozer blade can be changed relative to the ground level by pivotal movement of the supporting arms about the intermediate pivotal connection.

Another object of the present invention is to provide a structure as described in the object above wherein the hydraulic ram is mounted in a novel manner upon the tractor to provide a maximum force when pivoting the support arms about their intermediate pivotal connection to raise the elevation of the bulldozer blade relative to ground level and further to provide maximum absorption by the hydraulic actuator of any loadings on the bulldozer blade substantially transmitted through the supporting arms.

Still another object of the invention is to provide a pair of supporting arms pivotally connected at the forward end of the tractor substantially intermediate the ends of the arms, and with one of the outer ends of each of the arms pivotally connected to a bulldozer blade and the other outer end connected to a double-acting hydraulic ram. A plurality of adjustable strut means are further provided to maintain a pre-determined relative position of the bulldozer blade to the supporting arms about the connecting pivotal connection therebetween. One of the plurality of adjustable strut means further includes another separate adjustable means that provides tilting of the bulldozer blade about a longitudinal axis of the tractor. Finally, the plurality of strut means cooperate to provide additional rigidity to the pivotal connection of the bulldozer blade and the supporting arms.

An object of this invention is to provide a pair of supporting arms pivotally connected intermediate the ends thereof on the forward end of the tractor and with the outer ends of the supporting arms connected to a double-acting hydraulic ram and a bulldozer blade. Adjustable strut means are pivotally connected at their ends in a novel manner to the supporting arms and the bulldozer blade to maintain a predetermined relative position of the bulldozer blade and the supporting arms about their pivotal connection corresponding to a transverse axis of the tractor. Further, one of the adjustable means further includes a double-acting actuator such that upon actuation the bulldozer blade can be tilted about the longitudinal axis of the tractor. Other strut means are pivotally connected to the support arms and the bulldozer blade along the transverse axis to thereby permit the relative position adjustment and tilting adjustment of the bulldozer blade about the longitudinal axis. The double-acting hydraulic rams are mounted on the tractor such that with selective operation thereof, the hydraulic rams elevate the bulldozer blade relative to the ground level by pivotal movement of the supporting arms. Further, the double-acting hydraulic ram provides means that permit relative adjustment of the pair of supporting arms and the other strut means upon actuation of the one strut actuator for tilting of the bulldozer blade irrespective of the elevation of the bulldozer blade relative to the ground level, or the relative position of the bulldozer blade about the transverse axis.

Still another object of the invention is to provide a pair of duplicate supporting arms pivotally connected intermediate the ends thereof to the forward end of a tractor and which arms at the outer ends thereof are connected to a bulldozer blade and double acting hydraulic ram. A plurality of adjustable struts at their outer ends are pivotally connected to the supporting arms and the backwall portion of the bulldozer blade such that the adjustable struts cooperate to maintain a predetermined relative position of the bulldozer blade to the supporting arms about their pivotal connections corresponding to a transverse axis of a tractor. One of the adjustable plurality of struts further includes another separate adjustment that provides tilting of the bulldozer blade about a longitudinal axis of the tractor irrespective of the relative position of the bulldozer blade about the transverse axis. The double-acting hydraulic ram is mounted in such a manner on the tractor to provide a maximum actuating force to pivotally move the supporting arms to thereby raise the elevation of the bulldozer blade relative to the ground level, and the mounted double-acting rams further provide maximum absorption within predetermined limits of any loadings on the bulldozer blade during operation of the tractor that are substantially transmitted as loading forces through the supporting arms. Finally, the mounted hydraulic rams further include means that permits relative adjustment of the suporting arms in opposite direction upon adjustment of the one strut providing tilting of the bulldozer blade to thereby substantially reduce tilting reactionary forces in the bulldozer blade and supporting arms irrespective of the elevation of the supporting arms relative to the ground level.

Other objects and features of the present invention will be apparent upon a perusal of the following specification and drawings of which:

FIGURE 1 is a side elevational view of the adjustable bulldozer arrangement mounted on the front end of a four-wheel tractor vehicle;

FIGURE 2 is a top plan view of the adjustable bulldozer arrangement shown in FIGURE 1;

FIGURE 3 is a front elevational view of the adjustable bulldozer arrangement, illustrating the tiltable positions to either side about the longitudinal axis of the tractor;

FIGURE 4 is a perspective view showing the design of the supporting arms and struts as attached to the back portion of the bulldozer blade;

FIGURE 5 is an exploded fragmentary view showing the pivotal connection of one of the struts to the back portion of the bulldozer blade; and

FIGURE 6 is a schematic drawing of the hydraulic circuit for operator control to adjust the elevation of the bulldozer blade and to adjust the tilt thereof.

The present embodiment is the preferred embodiment, but it is to be understood that changes can be made in the present embodiment by one skilled in the art without departing from the spirit or scope of the present invention.

For a general description of the present invention, reference is made to the drawings.

A four-wheeled, rubber-tired tractor has mounted at the forward end, thereof, a pair of support arms pivotally mounted intermediate the ends thereof to the forward end of the tractor. The intermediate pivotal connection of the support arms is upwardly and forwardly of the forward wheel axle. Further, the outer ends of the support arms are pivotally connected to a bulldozer blade and a pair of double-acting hydraulic rams pivotally mounted to a pair of bracket supports attached near the operator's compartment. As shown in the drawings, namely FIGURE 1, the support arms are somewhat V-shaped with one section extending rearwardly along the tractor to pivotally connect to the hydraulic rams and the other section extending from the intermediate pivotal connection downwardly and forwardly to the forward end to pivotally connect to the bulldozer blade. Further, the support arms are between the inside of the wheels and the tractor. The plurality of adjustable struts are pivotally connected at their ends to the back-wall portion of the bulldozer blade and the support arms. Two of the adjustable struts are located substantially above the pivotal connection of the bulldozer blade and the support arms such that their adjustment determines the relative position or pitch of the bulldozer blade to the support arms about the pivotal connection that determines an axis transverse to the tractor. One of the two upper adjustable struts further includes an adjustment that comprises a double-acting actuator of fluid extensible means such that upon actuation thereof the bulldozer blade is tiltable about an axis longitudinal of the tractor such as shown in FIGURE 3. The remaining two adjustable struts are pivotally connected at their ends to the outer side edges of the bulldozer blade coaxial with the transverse axis and at their other ends to the support arms. The pivotal connection of these two struts to the outer edges of the bulldozer blade provides a ball and socket type connection shown in FIGURE 5, so that these two struts do not interfere with the pitch adjustment of the bulldozer blade or the tilting thereof. It should now be readily apparent that the four struts cooperate to provide rigidity of the bulldozer blade pivotal connection to the forward end of the support arms. A hydraulic circuit schematically shown in FIGURE 6 is provided to selectively control the operation of the hydraulic rams to elevate the support arms and bulldozer blade and the actuator for tilting the bulldozer blade. The hydraulic rams are mounted on the tractor so that the piston head portion of the cylinder provides the fluid actuating force for raising the bulldozer blade and thereby the maximum fluid force. Any loadings on a bulldozer blade during the operation of the tractor are substantially transmitted through the support arms to the hydraulic ram to be substantially absorbed by the volume of fluid in the piston head portion of the cylinder which is the maximum fluid volume. A series of relief valves of any suitable conventional construction are operatively associated with the pressure fluid conduits between the operator control valve and the hydraulic rams to limit the absorption force of any transmitted loading forces to thereby prevent damage to the hydraulic circuitry and/or the mechanical portions of the vehicle. During tilting of the bulldozer blade about the longitudinal axis, the support arms are permitted to pivotally move in opposite directions about their intermediate pivotal connection, since the piston rod assembly of the hydraulic rams are permitted opposite relative movement through a parallel connection of pressure fluod conduits to corresponding opposite ends of the cylinders of the pair of hydraulic rams as shown in FIGURE 6. In other words, the hydraulic rams act in effect as dash-pots during tilting of the bulldozer blade. It should now readily be apparent that irrespective of tilting adjustment or the relative position adjustment of the bulldozer blade, the bulldozer blade can be raised or lowered in elevation relative to the ground level through selective operation of the operator control valve to operate the hydraulic rams. It is further intended that the application of the subject invention is not to be limited to a four-wheeled, rubber-tired tractor but could readily be adapted by those skilled in the art to a crawler tractor or other equivalent tractor vehicles.

For a detailed description of the present invention, continued reference is made to the drawings. A tractor 10 as shown in FIGURE 1, comprises an operator's station 11 substantially between and above the transverse wheel axles 12 and 13 including wheels 12*a* and 13*a* supported in a conventional manner to the tractor frame 14. An adjustable bulldozer arrangement is generally indicated by the reference numeral 15, and includes a duplicate pair of support arms 16 substantially rectangular in cross-section, one being shown in FIGURE 1, that are somewhat V-shaped having a rearward section 17 extending along the tractor substantially parallel to the tractor frame 14, and a forward section 18 extending downwardly and forwardly to the forward end thereof namely 19 (FIGURE 4) to pivotally connect to the bulldozer blade 20 through a bracket 22 fastened to a backwall portion 20*a* of the blade 20. A bifurcated support bracket 21 suitably fastened to the tractor 10 such as by welding is located above and forwardly of the forward transverse wheel axle 12 to pivotally connect and support the support arm 16 between the forward and rear sections thereof through an assembled pin in a conventional manner.

A pair of double-acting hydraulic rams or actuators 23 are pivotally connected through their piston rod assembly 26 to the rearward end of the rearward section 17 through a conventional pin assembly. The cylinder 24 of the hydraulic ram 23 is pivotally mounted and supported to a bifurcated support bracket 25 fastened in a suitable manner such as welding to the tractor 10 forwardly of the operator's compartment 11. A schematic portion of the hydraulic circuit for controlling the operation of the hydraulic rams 23 is shown in FIGURE 1 in which the elements, operator control valve 27, pressure fluid conduits 37 and 36, relief valves 28, and reservoir 30 are indicated.

Turning now to FIGURE 6, the schematic diagram of the hydraulic circuit for the hydraulic rams 23 will now be described. The operator's control valve 27 has two valve spools 35 and 53 of the open center type construction that receives pressure fluid from reservoir 30 through operation of pump 31 delivering pressure fluid from suction conduit 32 to delivery conduit 33 and return through return conduit 34. The two hydraulic rams 23 shown in FIGURE 1 have pressure conduits 36 and 37 connected to opposite ends of the two hydraulic ram cylinders 24 through connecting branch conduits 38 and 39. The other ends of pressure conduits 36 and 37 are separately connected to ports on the operator control valve 27. A series of relief valves 28 of any suitable construction in the art are separately connected to the pressure conduits 37 and 36 and are illustrated here to include a compressible coil spring to urge the ball valve against its valve seat. The two relief valves 28 operatively connected to conduits 37 and 36 are connected to the reservoir 30 through return conduit 54 and branch conduits 40 and 41 directly connected to the relief valves 28. The relief valve 28 should provide a spring of predetermined value to limit fluid pressure of the hydraulic circuit so as not to damage the hydraulic circuitry during operation of the tractor caused by any sudden loadings or forces. In the neutral position of the valve spool 35 in the operator control valve 27, no pressure is delivered to the hydraulic rams 23 but is returned through return conduit 34 to the reservoir 30. However, upon the valve spool 35 being positioned in one operative position, pressure fluid is directed to the piston head end of the two cylinders 24 through pressure fluid conduits 36 and 38 to push the pistons downwardly and thereby pivotally move the support arms 16 about the brackets 21 in a counterclockwise direction to

raise the elevation of the bulldozer blade 20 relative to the ground level such as shown by dotted lines in FIGURE 1. Correspondingly, pressure fluid is removed from the piston rod ends of the two cylinders 24 and returned to reservoir 30 through the other pressure conduits 39 and 37, the operator control valve 27 and through return conduit 34. If the operator positions the valve spool 35 in another operative position, pressure fluid from pressure conduits 37 and 39 is delivered to the piston rod end of the two cylinders 24 to move the piston rod assembly 26 upwardly and thereby pivotally move the support arms 16 about the brackets 21 in the opposite or a clockwise direction to lower the elevation of the bulldozer blade 20 relative to ground level such as the ground engaging position shown in FIGURE 1. Correspondingly, upon upward movement of the piston rod assembly 26 pressure fluid from the two cylinders 24 at the piston head end thereof is removed through pressure conduits 38 and 36 to the return conduit 34 through control valve 27. During the operative positions of the control valve 27 parallel connected branch conduits 38 and 39 to corresponding ends of the cylinders 24 assist in pressure fluid movement of the piston rod assemblies 26. It should now be noted that the piston head end of the cylinder 24 is the maximum fluid volume of the ram 23, and thereby provides the maximum fluid force for raising the elevation of the bulldozer blade 20 and forward section 18 of the support arms 16 relative to the ground level in FIGURE 1.

Reference is now made to the adjustments of the bulldozer blade 20 which is best understood by referring to FIGURES 1 to 2 and 3. As briefly aforementioned, the bulldozer blade 20 is of general construction and comprises the back wall portion 20*a*, side walls 20*b*, and cutting edge 20*c*. The forward end 19 of the support arms 16 are further bifurcated so that the bifurcation overlaps the spaced-apart brackets 22 extending rearwardly from the back wall portion 20*a* to be assembled to the forward end 19 through aligned openings and transverse assembling pins on self-aligning bushings in the conventional manner best shown in FIGURE 4. Two adjustable upper struts 49 and 49*a*, of a similar but not identical configuration are pivotally connected to the brackets 44 on the back wall 20*a* and the brackets 45 on the forward section 18 above and immediately adjacent the intermediate pivotal connection of the support arms 16 on the brackets 21. The brackets 45 are bifurcated and include a cover plate 45*a* partially covering the bifurcated opening. The brackets 44 on the back wall 20*a* are also bifurcated.

The upper strut 49*a* comprises an adjustable jack means including links 46 and 47 having threaded portions 46*a* and 47*a* threadedly assembled to a cylinder collar 48. Link 47 opposite its threaded portion 47*a* has an enlarged portion with an opening that aligns with transverse openings in bracket 44 to provide assembly by a transverse pin. The other end opposite the threaded portion 46*a* of link 46, includes a piston 52 within the cylinder 51 of the double-acting hydraulic actuator or fluid extensible means 50. The cylinder 51 has an extending portion 51*a* that assembles within the bifurcated opening of bracket 45 wherein the aligned openings of portion 51*a* and bracket 45 are also assembled by a transverse pin. Thus, the outer ends, cylinder portion 51*a* and enlarged portion of link 47 of strut 49*a* are pivotally connected to brackets 44 and 45. It is to be understood that the threaded portions 46*a* and 47*a* are oppositely threaded and engage complementary internal threads on the collar 48 such that the operator can manually rotate the collar 48 to lengthen or shorten the upper strut 49*a* and thereby change the pitch of the bulldozer blade 20.

The other upper strut or tilt brace, generally indicated by the reference number 49, is located vertically above the other forward section 18 of the other support member 16 shown in FIGURES 2 and 4 and pivotally connected to corresponding identical brackets 44 and 45 on the other support arm and black wall 20*a*. The strut 49

comprises links 46 and 47 having opposite threaded portions 46*a* and 47*a* assembled together by a second cylindrical collar 48 internally threaded in a corresponding engaging manner. Link 46 further includes opposite its threaded portion 46*a* an enlarged portion 46*b* with a transverse opening alignable with corresponding transverse openings in brackets 45 for assembly of a pin to provide the pivotal connection thereto. Similarly, link 47 has an enlarged portion for pivotal connection to the bracket 44 and is identical in construction to the link 47 associated with the first upper strut 49*a*. Thus, it should now be apparent that manual adjustment of collar 48 on the upper strut 49 by the operator, cooperates with the manual adjustment of first strut collar 48 to adjust the relative position or pitch of the bulldozer blade 20 about the transverse axis 70 of the tractor.

The bulldozer blade 20 is further additionally adjustable by tilting about an axis 71 longitudinal of the tractor through actuation of the double-acting actuator 50 on the first upper strut 49*a* as described below. As shown schematically, in FIGURE 6, the hydraulic actuator 50 is connected directly to the control valve 27 and its valve spool 53 through pressure conduits 56 and 57 at opposite ends of the cylinder 51. With the control valve spool 53 in a neutral position, pressure fluid from pump 31 flows freely to the reservoir 30 through conduits 33 and 34 and the control valve 27. Upon movement of the valve spool 53 to one operative position, pressure fluid from conduit 33 is directed to pressure conduit 56 to move the piston 52 toward the rod end of the cylinder 51, thereby extending the length of the upper strut 49*a* to cause tilting of the bulldozer blade 20 as shown by dotted lines in FIGURE 3. Upon movement of the valve spool to another operative position, pressure fluid is directed to pressure conduit 57 to move the piston 52 towards the piston end of the cylinder 51 and thereby shorten the length of the upper strut 49*a* to tilt the bulldozer blade in the other position as shown in FIGURE 3. It should now be apparent to those skilled in the art that when one of the conduits 56 is delivering pressure fluid, the other conduit 57 is returning fluid via the return conduit 34 to the reservoir 30 through the control valve 27.

During tilting of the bulldozer blade, the operator control valve spool 35 of the valve 27, FIGURE 6, remains in neutral position so that the pressure fluid in hydraulic rams 23 is hydraulically locked to maintain the piston rod assembly 26 in substantially the same adjusted elevated position. However, upon actuation of the actuator 50 for tilting the bulldozer blade 20 about the longitudinal axis 71 of the tractor 10, reactionary tilting forces are created in the pivotally connected bulldozer blade 20 and the support arms 16, such that if the actuator 50 is actuated to extend the length of the upper strut 49*a* the reactionary forces in the bulldozer blade 20 and the support arm 16 pivotally connected to the extended strut 49*a* shown in FIGURE 1 tend to rotate the bulldozer blade about the longitudinal axis 71 as shown by dotted lines in FIGURE 3. With the control valve 27 in the neutral position, the piston rod assembly 26 of the hydraulic rams 23 is permitted to move in opposite directions and thereby allow the support arms 16 to pivotally move in opposite directions about their intermediate pivotal connection, since the reactionary forces upon extension of the strut 49*a* causes support member 16 shown by dotted lines in FIGURE 1 to pivot counterclockwise and displace pressure fluid to the corresponding end of the other cylinder 24 through the parallel connecting conduit 39 thereby moving the other piston rod assembly 26 upwardly and the other support arm 16 to pivotally move clockwise (not shown in FIGURE 2). Then, pressure fluid from the piston end of the upwardly moving piston rod assembly 26 in the other cylinder 24 is displaced to the corresponding end of the one cylinder 24 through parallel connecting conduit 38. Thus, it should now be readily apparent, if the control valve 53 is moved to another

operative position to lengthen the upper strut 49*a* the bulldozer blade 20 will be tilted in the other direction as shown in FIGURE 3 and the reactionary forces in the pivotally connected bulldozer blade 20 and support arms 16 will be opposite the direction to the other reactionary forces when the upper strut 49*a* was extended, such that the support member 16, shown in FIGURE 1, and which is connected to the upper strut 49*a* will pivotally move in reaction to the opposite reactionary forces in a clockwise direction and thereby transfer fluid through parallel connecting conduit 38 to the corresponding end of the other cylinder 24. Similarly, the other cylinder 24 will react to move the piston rod assembly 26 downwardly to thereby pivotally move the other support arm 16 in a counterclockwise direction and transfer fluid through conduit 39 to the corresponding end of the one cylinder 24.

In addition to the rigidity provided by the two struts 49 and 49*a* in maintaining the tilting and relative position or pitch adjustments of the bulldozer blade 20, two outer diagonal adjustable struts 58 of identical construction are pivotally connected to the bulldozer blade 20 and support members 16 as described below. Since the struts 58 are identical, only one will be described in detail and comprises a pair of opposed links 60 and 61 having opposite threaded portions, similar to links 46 and 47, to be assembled together by a cylindrical coupling collar 62 having internal corresponding engaging threads, not shown. Adjacent the side walls 20*b* of the bulldozer blade 20, and at the back wall 20*a* of the bulldozer blade 20, a solid portion 63 is integrally formed in the back wall 20*a* having a hemispherical recess 64, shown in FIGURE 5, with its center coinciding with the transverse axis 70. Opposite the threaded portion of the link 61 is an enlarged spherical ball portion 80 corresponding in diametrical size to the hemispherical recess 64 of the back wall portion 63. The ball portion 80 is assembled to the hemispherical socket recess 64 through an adapter plate 65 having a transverse opening 66 smaller at its outer end than at its inner end. In FIGURE 5, the larger inner end of the transverse opening 66 comprises an arcuate surface of revolution having its center on the transverse axis 70. The arcuate surface of revolution of the inner end in the opening 66 defines a segment of the hemisphere to secure the spherical portion 80 in the hemispherical recess 64 upon fastening of the adapter plate 65. Further in FIGURE 5, the smaller outer end of the opening 66 on the plate 65 is an inclined surface of revolution of sufficient inclination relative to the longitudinal axis of the strut 58 to permit freedom of movement of the assembled ball portion 80 in the recess 64 to provide tilt or pitch adjustments of the blade 20 about the longitudinal axis 71 and the transverse axis 70. Thus, one of the purposes of the two struts' 58 spherical pivotal connection on the transverse axis 70, is to permit pitch adjustment of blade 20 about the transverse axis 70. Another of the purposes of the spherical connection is to permit tilting adjustment of the transverse axis 70 about the longitudinal axis 71 irrespective of the pitch adjustment and thereby opposite pivotal movement of the supporting arms 16 through relative transfer of pressure fluid to opposite ends of hydraulic ram cylinders 24 through parallel connected conduits 38 and 39 as previously described. The adapter plate 65 is fastened in a suitable manner such as by fasteners 67. Opposite the threaded portion of link 60, not shown, an enlarged portion, corresponding to portions 46*b* of the upper strut 49, is assembled to bifurcated bracket 68 through an aligned transverse opening therethrough and an assembly pin. Bifurcated bracket 68 also has a cover plate 68*a* and corresponds in detail to brackets 45 for the upper struts 49 and 49*a* but the brackets 68 are positioned and fastened substantially intermediate along the outer side wall of the support arms 16 between the intermediate pivotal connection 21 and the forward end 19 of the forward section 18 of the support arm 16 as shown in the drawings. Thus, the diagonal struts 58 are pivotally connected to the support arms 16 and the back wall 20*a* of the bulldozer blade 20 to provide further rigidity in addition to the rigidity of the upper struts 49 and 49*a*, but through the ball pivotal connection on the transverse axis 70, the outer struts 58 do not interfere with the tilting or pitch adjustments of the bulldozer blade 20.

In view of the foregoing detailed description, the operation of the adjustable bulldozer blade arrangement 15 will now be set forth below. The operator first adjusts the pitch adjustment of the bulldozer blade 20 relative to the support arms 16 through rotation of adjusting collars 48 on the upper struts 49 and 49*a*. The purpose of the pitch adjustment is to determine the proper angle of attack for the cutting edge 20*c* for the earth material being worked upon. Then the operator selectively operates the valve spool 35 of the operator control valve 27 to raise and lower the bulldozer blade 20 relative to ground level such as the ground engaging position shown in FIGURE 1.

If any loadings occur during the operation of the tractor 10 they are substantially transmitted through the bulldozer blade 20 and pivotally connected support arms 16 to the maximum fluid volume end of the cylinders 24 to be absorbed by the pressure fluid therein. That is, the majority of the shock loads will be applied to the blade 20 in such a manner as to pivot the arms 18 in a clockwise direction, as viewed in FIGURE 1. This will cause the pistons in cylinders 24 to move toward the head end. Thus the increase in hydraulic pressure is less than would be developed by the same loading acting on the rod end because the area of the piston is greater on the head end than on the rod end. Consequently, a heavier load could be tolerated in the head end to develop the same hydraulic pressure a smaller load would create in the rod end. If the loading forces to be absorbed by the pressure fluid exceeds a predetermined value, the relief valve means 28 function to open and thereby release the pressure fluid through conduits 40 and 41 to the reservoir 30 to prevent damage to the hydraulic circuitry and/or tractor mechanism.

If the operator during the operation of the tractor desires to bulldoze a gradual slope, in other words, to have a grader effect, the bulldozer blade is tilted about the longitudinal axis 71. Assuming that the upper strut 49*a* is extended by actuation of actuator 50 the reactionary tilting forces in bulldozer blade 20 and the support arm 16 connected to the one upper strut 49*a* reacts to pivotally move the one support arm 16 in a counterclockwise direction shown by dotted lines in FIGURE 1 so that the bulldozer blade 20 is tilted to a tilted position such as shown by dotted lines in FIGURE 3. During tilting, the hydraulic ram 23 functions to substantially receive the reactionary forces in the bulldozer blade 20, and the oppositely moving support arms 16 through transfer of pressure fluid by transfer conduits 38 and 39 from corresponding ends of cylinders 24 so as to oppositely move piston rod assemblies 26. As aforedescribed, the bulldozer blade 20 will be tilted in the opposite direction as shown in FIGURE 3 about the longitudinal axis 71 upon shortening the length of upper strut 49*a* through the operator's control of the control valve spool 53. Then the one support arm 16 operatively connected to the upper strut 49*a* due to the reactionary tilting forces being in the opposite direction causes the one support arm 16 to now pivotally move in the clockwise direction. Irrespective of tilt adjustment or pitch adjustment of the bulldozer blade 20, the operator can readily still change the elevation of the support arms 16 and the bulldozer blade 20 within operative limits relative to ground level. Thus, the operator can selectively operate the hydraulic ram control valve spool 35 to direct pressure fluid to the piston head end of cylinders 24 to provide the maximum

fluid force to raise the elevation of the support arm **16** or direct pressure fluid upon another operative position of the control valve spool **35** to apply pressure fluid to the piston rod end of cylinders **24**, lesser than the maximum fluid force of the piston head end, to thereby lower the elevation of the bulldozer blade **20** relative to the ground level. It should now be readily apparent by those skilled in the art, that other earth engaging attachments other than the bulldozer blade **20**, could be attached to the novel support arm arrangement to thereby take advantage of its operative characteristics.

Having described the invention, what is considered new and desired to be protected by Letters Patent is:

1. A mounting for attaching a blade to a tractor comprising: a pair of spaced apart push arms each pivotally mounted at a point intermediate its ends on said tractor, said blade being pivotally attached to the forward ends of said arms; a pair of double-acting lift cylinders of equal capacity pivotally attached to said tractor and to the rearward ends of said push arms; a double-acting tilt cylinder means pivotally mounted on one of said push arms and pivotally secured to said blade; an adjustable jack means included in said tilt cylinder means between said blade and said push arms; an adjustable tilt brace pivotally secured to the other of said push arms and to said blade; fluid circuit means including a fluid pressure source and a control valve hydraulically connected to the rod and head ends of each of said lift cylinders and to the rod and head end of said tilt cylinder means whereby upon selective movement of said control valve said blade is raised and lowered and said blade is tilted; first conduit means interconnecting the rod ends of each of said lift cylinders; and second conduit means interconnecting the head ends of each of said lift cylinders whereby when said tilt cylinder means is actuated said push arms can pivot in opposite directions in response to the forces set up in said lift cylinders to relieve the stresses created by the tilting of said blade.

2. A mounting for attaching a blade to a tractor according to claim 1 and further comprising a pair of adjustable struts, one end of each of said struts pivotally connected to one of each of said push arms and the other end of each of said struts pivotally connected to the blade at opposite outer portions, thereby providing support for the outermost ends of the blade.

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