United States Patent

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[15] **3,700,044**

[45] **Oct. 24, 1972**

[54] **HYDRAULIC SYSTEM FOR CONTROLLING BULLDOZER BLADE**

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[22] Filed: **Sept. 21, 1970**

[21] Appl. No.: **73,836**

[52] **U.S. Cl.**.....**172/804,** 91/413

[51] **Int. Cl.**.....**E02t 3/76**

[58] **Field of Search**.....172/801–807; 91/413; 74/471; 37/DIG. 7

[56] **References Cited**

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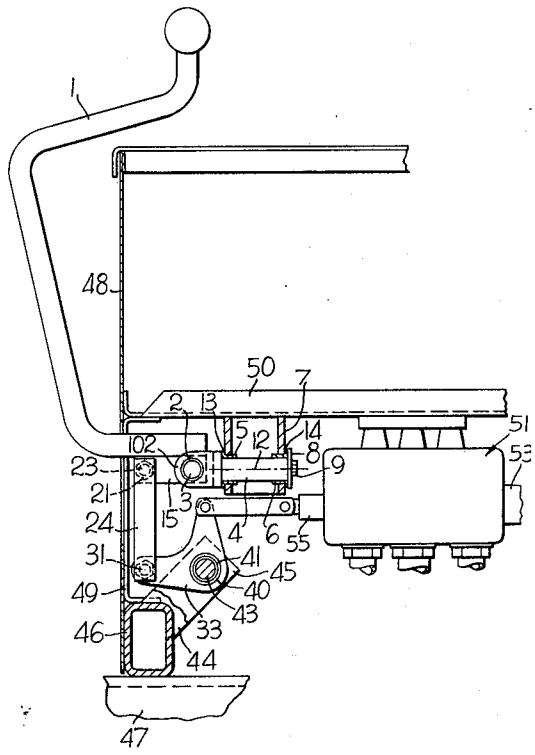
[57] **ABSTRACT**

A single lever control valve means for controlling hydraulic actuators to pitch and tilt a bulldozer blade.

10 Claims, 6 Drawing Figures



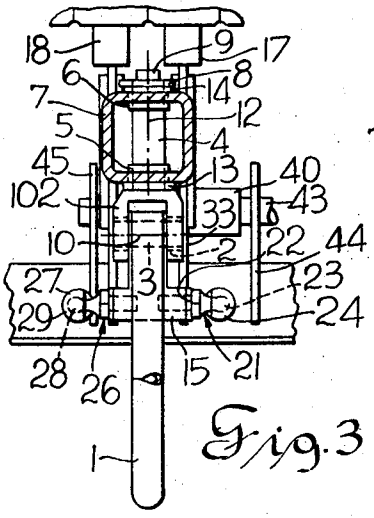


Fig. 3

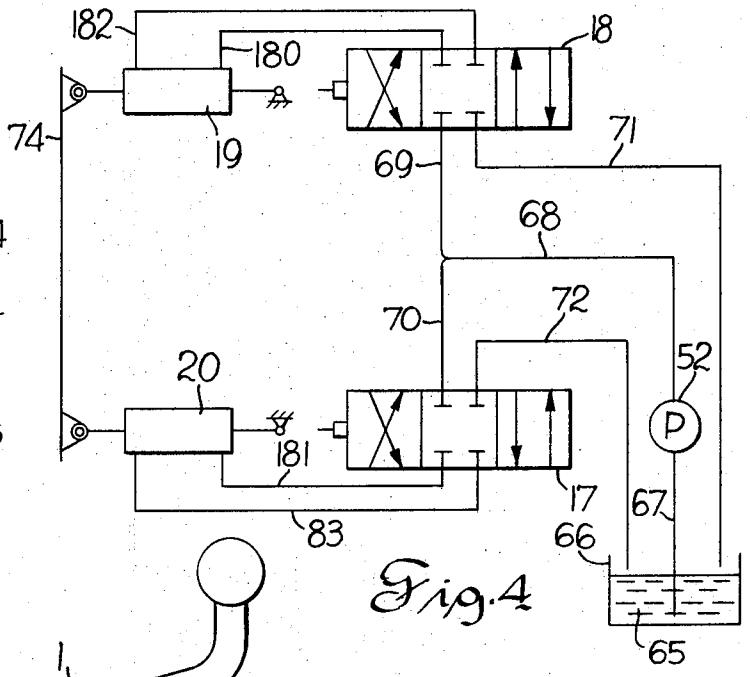


Fig. 4

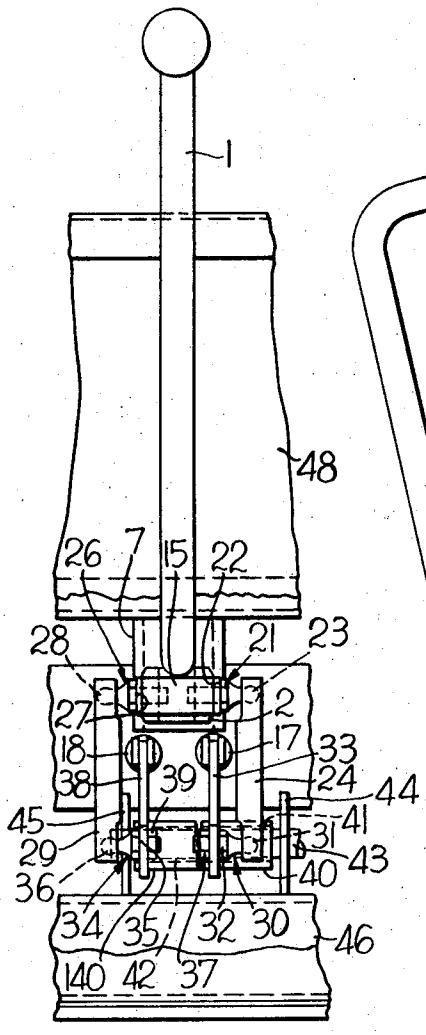


Fig. 2

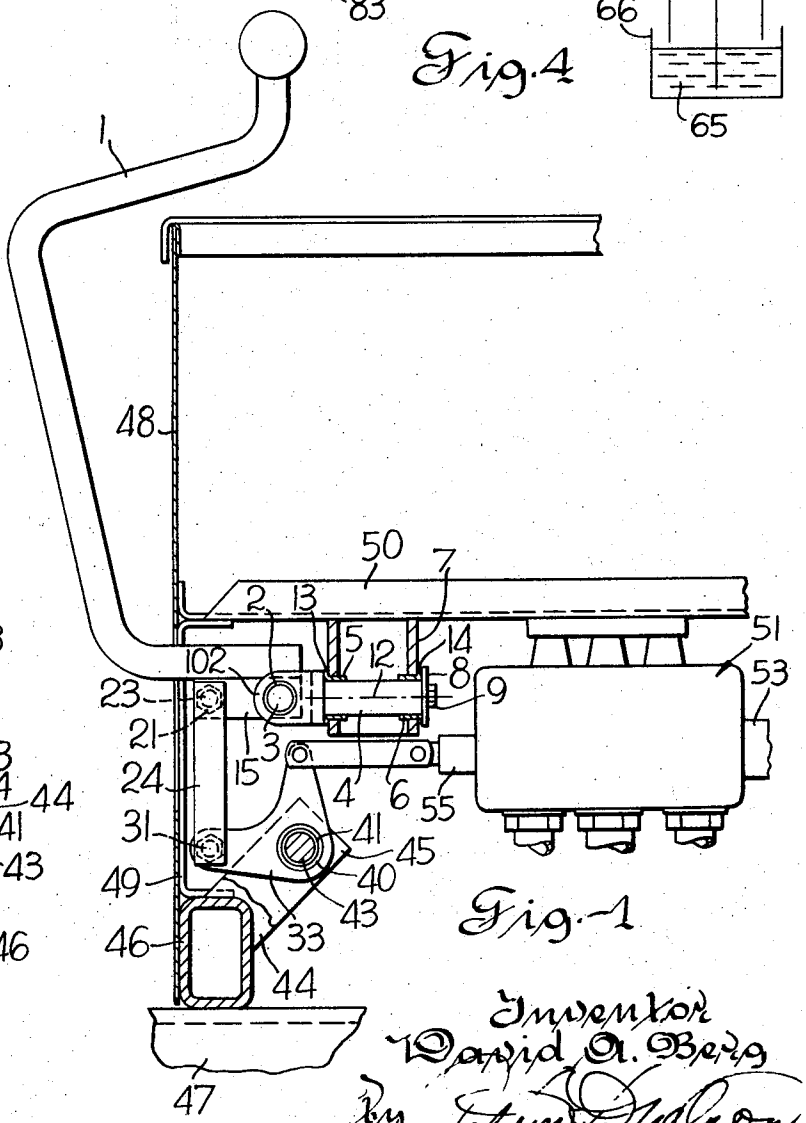


Fig. 1

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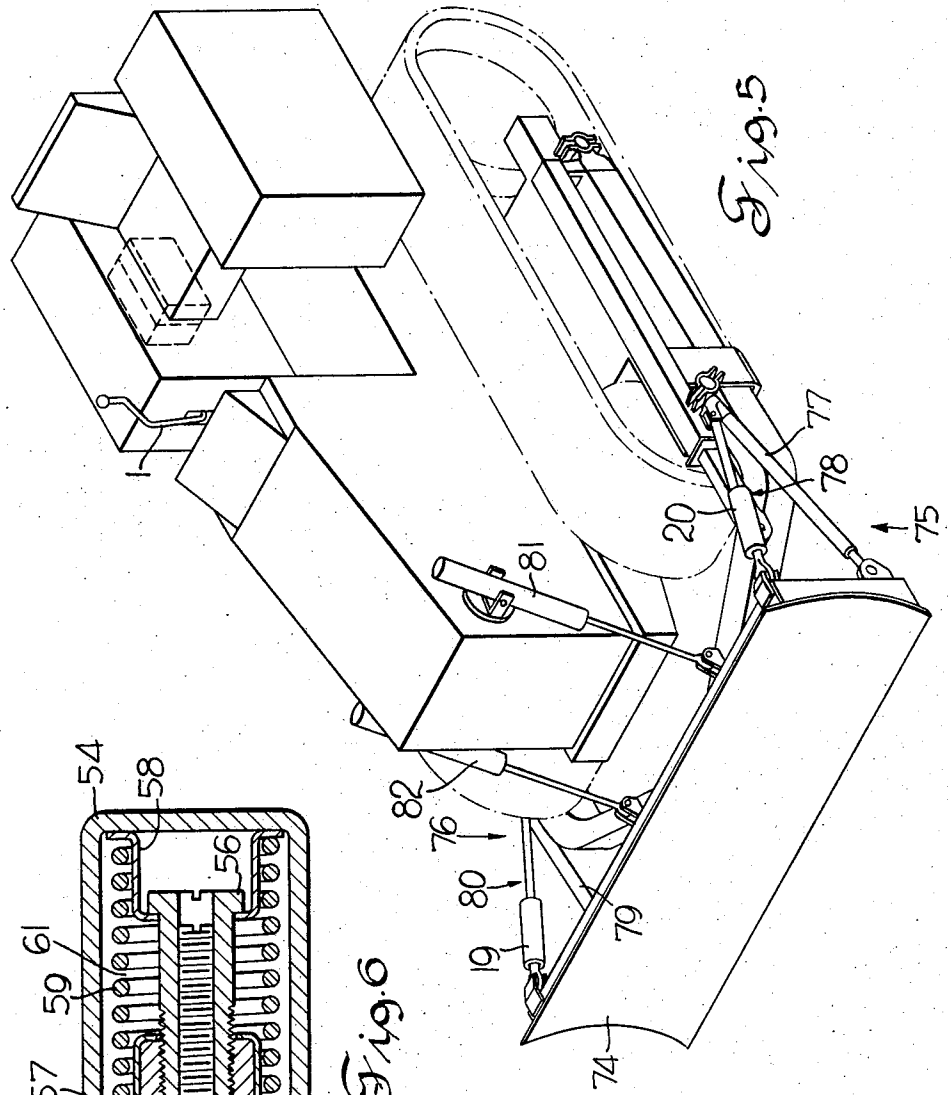

Fig. 5

Fig. 6

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HYDRAULIC SYSTEM FOR CONTROLLING BULLDOZER BLADE

This invention relates to a hydraulic system controlling the bulldozer blade and more particularly to a single lever control valve means to operate hydraulic actuators for pitching and tilting a bulldozer blade.

A bulldozer blade on a tractor is generally mounted for universal movement relative to the chassis of the vehicle. A conventional C-frame pivotally mounted on the chassis carries a central universally connected pivotal arrangement supporting the central portion of the bulldozer blade. A ram provides assembly and support arms on each side of the C-frame supporting means for the bulldozer blade on each end and also universal connection to permit tilting, pitching, angling of the bulldozer blade relative to the vehicle chassis. A hydraulic actuator means is usually positioned for raising and lowering of the C-frame and bulldozer blade.

Angling of the bulldozer blade is not always hydraulically controlled and may be accomplished by a mechanical connection which can be preset prior to performing an earthmoving or excavating operation. Hydraulic control with hydraulic means on the ram assembly is, however used to extend or retract the ram assemblies and angle the bulldozer blade. Since this operation is used less often than the pitch and tilt operation it can be accomplished with a separate additional lever with no real inconvenience to the operator.

The pitch and tilt operations are used more frequently and for convenience a single lever control for both operations provides a more versatile arrangement for movement of the bulldozer blade. The pitch and tilt operations are actuated by separate hydraulic actuators connected between the C-frame and the bulldozer blade. The separate actuators are operated by separate valves through a lever arrangement.

Accordingly, this invention provides a simplified control utilizing a single lever which pivots on two axes. A hydraulic actuator is positioned in each ram assembly which pivots the upper portion of each side of the blade forwardly or rearwardly relative to the lower portion of the blade. Each hydraulic actuator is controlled through a valve which is connected to the single lever control. When the single lever control actuates to extend the push arms of the ram assemblies on each side of the C-frame the blade is pitched. When the single lever control is moved on a second axis one of the pusharms extends while the opposite pusharm retracts to produce a warping effect on the blade which tends to lower one side and raise the opposite side. Accordingly, when the single lever control is pivoted on this axis, the blade is pitched in one direction or the other depending on the direction of pivotal movement of a single lever control.

Accordingly, this arrangement provides a single lever control pivotal on two axes which permits the operator to pitch or tilt or provide a combination of pitching or tilting by the use of a single lever and permitting the operator to have the other hand available for other controls.

Accordingly, it is an object of this invention to provide a single lever control operating a valve means to selectively operate hydraulic actuators of a bulldozer blade singularly in either direction to extend the pusharms, or simultaneously extending and retracting the pusharms to selectively provide a pitch and tilt operation of the bulldozer blade.

It is a further object of this invention to provide a single lever control valve means operating a hydraulic actuator in each of two ram assemblies for simultaneous extension of said actuators to pitch the blade, or simultaneous extension and retraction of opposing actuators on opposite sides of the blade to selectively tilt the blade.

The objects of this invention are accomplished by mounting a C-frame for pivotal movement about a horizontal axis on the chassis of the vehicle. The forward end of a C-frame is universally connected to the center point on the bulldozer blade. The ram assembly on each of the side beams of the C-frame provides a means for angling of the bulldozer blade through universal connections on the front end of the ram assemblies to each end of the bulldozer blade. The ram assembly includes a strut connected to the lower portion of the blade and a pusharm connected to the upper portion of the blade with each arm including a hydraulic actuator to rotate the blade on a transverse axis when both actuators are operated to extend the pusharms. The actuators also have means for simultaneously extending and retracting opposing hydraulic actuators to produce a pitching of the bulldozer blade on a longitudinal axis. The control for the hydraulic actuator is provided through a single lever control which is pivotal about two axes to permit actuation of a valve for each of the actuators which extends both actuators when the lever is pivoted on a first axis and extends and retracts opposing actuators when pivoting on a second axis. Accordingly, a single lever control and control valve will provide a control for pitching and tilting of a bulldozer blade as desired by the operator.

The preferred embodiments of this invention are illustrated in the attached drawings.

FIG. 1 is a side view partially in section of a single lever control and the hydraulic control valve;

FIG. 2 is a front view of a single lever hydraulic control valve for operating the bulldozer blade;

FIG. 3 is a plan view illustrating a single lever control and the hydraulic valves;

FIG. 4 is a schematic illustration of the hydraulic system for operating the hydraulic actuators of the bulldozer blades;

FIG. 5 illustrates an isometric view of the single lever control on a tractor carrying a bulldozer blade; and

FIG. 6 is a cross section view of the return spring on the hydraulic control valve.

Referring to the drawings, the single lever 1 is welded to the T-block 15 which is supported for rotation about axis 10 on the stub shaft 3 journaled in bushings 2 of clevis 102. The clevis 102 is integral with the shank 4 which is received in the bushings 5 and 6 supported by the bearing bracket 7. The washer 8 is fastened on the end of a shank 4 by means of a nut 9 which holds the washer 8 in position against the radial flange 14 of the bushing 6. The radial flange 14 of the clevis 102 firmly seats against the radial flanges 13 of bushing 5. The flanges 13 and 14 operate as thrust bearings between the clevis 102 and the bracket 7 as well as the washer 8 and bracket 7. The single lever 1 is also free to rotate about the axis 12.

The clevis **102** supports the T-block **15** through the stub shaft **3** which is journaled in the T-block **15**. The T-block **15** extends underneath the lever **1** to which it is welded. The lever **1** and the T-block **15** pivot on the stub shaft **3** which defines the pivotal axis **10**. The pivoting of lever **1** about the transverse axis **10** operates both valve **17** and **18** simultaneously to extend or contract actuators **19** and **20**. The lever **1** is held in a neutral position by centering springs in the valve assembly.

The lever **1** can be pivoted transversely about axis **12** as the shank **4** rotates within the bushings **5** and **6**. The T-block **15** is threaded on each end to receive a bolt **21** which has a shoulder **22** and a spherical head **23** which is received in a socket of link **24**. The bolt **26** forms a hectagon shoulder **27** and a spherical head **28** which is received in a spherical socket of link **29**. Link **24** is similarly connected to a bolt **30** which also has spherical head **31** and hexagon shoulder **32** and which is fastened to the bellcrank **33**. The link **29** extends downwardly and is connected to a bolt **34** having a hectagon shoulder **35** and spherical head **36**. The bolt **30** is fastened to the bellcrank **33** by the nut **37** while the bolt **34** is fastened to the bellcrank **38** by the nut **39**. Bellcrank **33** is connected to the sleeve **40** while bellcrank **38** is fastened to the sleeve **140**. The sleeve **40** carries a bushing **41** while sleeve **140** carries a bushing **42**. The bushings **41** and **42** encircle the shaft **43** which is supported on brackets **44** and **45** which are connected to the tubular member **46**. The tubular member **46** is supported by the chassis **47**. The tubular member **46** also is connected to the end wall **48** and channel **49** which is fabricated with the formed plate **50** to provide a supporting structure for the valve assembly **51**. The valve assembly **51** is provided with suitable conduits for connection to the hydraulic actuators **19** and **20** as well as the pump **52**.

The valve assembly **51** comprises two valves **17** and **18**. Each valve transmits fluid in one direction in response to movement of the bellcranks **33** and **38** in the first direction of the rotation and transmits fluid in the opposite direction in response to counterrotation of the bellcranks **33** and **38** in the opposite rotational direction. Each bellcrank is returned to a neutral position by a spring mechanism in the valves which in turn likewise returns the lever **1** to a neutral position. The valves **17** and **18** each include the return springs as shown in FIG. **6** which will be described subsequently.

The valve housing **53** supports a spring casing **54**. The spool **55** moves reciprocally within the valve housing and threadedly receives the screw **56**. The end of the spool **55** supports the spring seat **57** while the screw **56** supports the spring seat **58**. The spring **59** is compressively positioned between the two spring seats. The spring seat **57** abuts the end of the housing **53** in the neutral position while the spring **58** abuts the inside end of the spring casing **54** when in the neutral position. When the valve is actuated and released with a space between the end of the spring casing **54** and the spring seat **58**, spring **59** will cause a return movement of the spool in the right-hand direction while a clearance between the spring seat **57** and housing **53**, spring **59** will cause a return movement of the spool **55** in the opposite direction to a neutral position. The force of this spring **59** returns the valve to a neutral position which likewise returns each of the bellcranks **44** and **45** to their centered position as well as the centered position of the lever **1** about the axes **10** and **12**. FIG. **1** and **2** for the purpose of illustration shows the neutral position of the lever **1** on both axes described.

FIG. **4** illustrates the hydraulic system which includes a pump **52** receiving hydraulic fluid **65** from the reservoir **66**. The conduit **67** connects a pump to the reservoir **66**. The high pressure side of the pump **52** is connected to the conduit **68** which is in communication with the conduits **69** and **70** leading to valves **18** and **17** respectively. A return conduit **71** returns fluid from valve **18** while the return conduit **72** returns fluid from valve **17** to the reservoir **66**.

Valves **18** and **17** are three position valves for transmitting fluid to the actuators **19** and **20**. The actuators **19** and **20** provide a pivoting and tilting action for the bulldozer blade **74**. The bulldozer blade **74** is connected to the ram assemblies **75** and **76**. The ram assembly **75** includes a lower strut **77** and a pusharm **78** which includes actuator **20**.

The ram assembly **76** includes a lower strut **79** and pusharm **80** which includes the hydraulic actuator **19**. The ram assembly **75** includes a hydraulic actuator for angling as does the ram assembly **76** and a suitable control system for angling the blade about a vertical axis.

The bulldozer blade **74** can be lifted by suitable actuators in a hydraulic system through the hydraulic actuator **81** and **82**. A control lever **1** is shown on the vehicle at the operator's station for the control of the pitch and tilt of the bulldozer blade **74**.

The operation of the device will be described in the following paragraphs.

Referring to FIG. **4** the pump **52** is driven by a suitable source of power and draws fluid from the reservoir **66** through the conduit **67**. The pump pressurizes fluid in conduits **68, 69** and **70** which is transmitted through the valves **17** and **18** to the hydraulic actuators **20** and **19** in response to actuation of the valves.

The blade **74** is controlled by the single lever **1**. The supplying of pressurized fluid to the actuators **19** and **20** to simultaneously extend the actuators in the struts **80** and **78** will pitch the blade about a transverse axis by causing the top portion of the blade to roll forwardly relative to the lower portion of the blade. The blade can be pitched rearwardly by contracting both of the hydraulic actuators **19** and **20** which causes the blade to pivot also about the pivotal connection of the lower struts **79** and **77**.

The blade **74** can be tilted by the contraction of one of the actuators with simultaneous extension of the other hydraulic actuators **19** and **20**. This is accomplished by reversing the movement of the valve **17** while simultaneously moving the valve **18** forwardly or vice versa. While one actuator contracts the other actuator extends and produces a warping effect on the blade which in turn will cause the blade to lift on one side and be forced downwardly on the opposite side. The tilting action is produced by moving the single lever **1** sidewards to one side or the other depending on the direction of tilt required.

The single lever **1** is shown in FIGS. **1, 2** and **3** with its specific mounting on the vehicle. As the lever **1** is moved forwardly to rotate about axis **10** both of the bellcranks **33** and **38** rotate in a counterclockwise

direction as shown in FIG. 1. With the counterclockwise rotation of the bellcranks the valves 17 and 18 are both moved forwardly permitting communication between the pump and the rearward side of the actuators 19 and 20 through conduits 180 and 181 respectively. The fluid on the opposite side of the piston in the actuators returns through conduits 182 and 83 through the valves 18 and 17 to the reservoir 66. When the lever 1 is pivoted rearwardly as shown in FIG. 1 the bellcranks 33 and 38 also rotate in a clockwise direction causing the hydraulic actuators 19 and 20 to contract. When the lever 1 is rotated in a rearward direction or clockwise direction the bellcranks 33 and 38 are also rotated in a clockwise direction and the pressurized fluid flows through the valves 17 and 18 to contract the hydraulic actuators 20 and 19.

The single lever control can be rotated about the longitudinal axis 12 which will produce a reversal of the direction of motion of the valves 17 and 18 relative to each other. When the single lever 1 is rotated in a clockwise direction as shown in FIG. 2 the bellcrank 33 will rotate in a counterclockwise direction as shown in FIG. 1 while the bellcrank 38 will rotate in a clockwise direction as shown in FIG. 1. This will cause pressurized fluid from the pump to flow through the valve 17 to extend the hydraulic actuator 20 while the pressurized fluid will flow through valve 18 to contract the hydraulic actuator 19. With an extension of hydraulic actuator 20 and contraction of hydraulic actuator 19 the blade will lift on the side of the actuator 19 and lower the blade on the side of the hydraulic actuator 20.

When the single lever control is moved in the counterclockwise direction as shown in FIG. 2 the reverse situation is accomplished and the hydraulic actuator 19 extends while the hydraulic actuator 20 contracts which in turn will cause the blade to tilt by raising the blade on the side of the hydraulic actuator 20 and lowering the side of actuator 19. Accordingly, the tilt and the pitch is controlled by the single lever and is dependent upon which axis of rotation the single lever 1 is rotated about.

It is understood that each of the valves 19 and 20 include a return spring 59 as shown in FIG. 6 when the valve spool is moved forwardly the spring 59 is compressed and the spring seat 58 moves away from the end of the spring casing 54. As soon as the lever is released the spring 59 forces the spring seat 58 up against the end wall of the spring casing 54. The reverse situation is true when the spool 55 is moved in a right-hand direction. The spring seat 57 moves in the right-hand direction away from the wall 85 of housing 53. When the lever is released the spring 59 moves the spring seat 57 against the cylinder wall and returns the valve to a neutral position and simultaneously returns the control lever 1 to its neutral position.

When the lever 1 is moved in a transverse direction and rotates about the axis 12 the same springs return the lever to its neutral position. The only difference is that the spring seat 58 is moved away from the spring casing 54 in the one actuator while the spring seat 57 is moved away from the wall 85 of housing 53 in the other valve. The spring 59 returns the spool to its normally neutral position when the lever is released. This again will return the lever to its neutral position when rotated in a transverse direction.

Accordingly, the preferred embodiment of this invention has been illustrated and described. The single lever controls pitch and tilt of the blade 74 in response to the direction of movement of the lever. The lever 1 always returns to a neutral position in response to spring actuators in the valve assemblies.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A hydraulic means for operating a bulldozer blade comprising, a vehicle, a bulldozer blade universally mounted on said vehicle for pivotal movement about a transverse axis to pitch said blade and for the pivotal movement generally about a longitudinal axis to tilt said blade, a pair of ram assemblies pivotally supported on said vehicle, each ram assembly including a strut and a pusharm universally connected to the lower and upper portion of said blade respectively, a hydraulic system including a source of pressurized fluid, a hydraulic actuator in each of said pusharms for extending or contracting said pusharms, a control valve connected between said source and each one of said actuators controlling the flow of pressurized fluid from said source to said hydraulic actuators, resilient means connected to each of said control valves normally biasing said valves to a centrally neutral position, a single control lever, means connecting said lever to both control valves to simultaneously control the flow of hydraulic fluid to each of said hydraulic actuators, pivotal support means supporting said lever for pivotal movement about two axes transverse to the length of the lever, said pivotal support means defining a first pivotal axis essentially parallel with said transverse axis whereby pivotal movement of said lever about said first axis provides simultaneous extension of said actuators to pitch said blade, said pivotal support means defining a second pivotal axis essentially parallel with said longitudinal axis whereby pivotal movement of said lever about said second axis differentially extend and contract said hydraulic actuators to tilt said blade and to thereby provide pivotal movement of said lever to simulate movement of said blade.

2. A hydraulic means for operating a bulldozer blade as set forth in claim 1 wherein said hydraulic actuators include double acting hydraulic actuators.

3. A hydraulic means for operating a bulldozer blade as set forth in claim 1 wherein said control valves include spring means biasing said valves and control lever to a neutral position.

4. A hydraulic means for operating a bulldozer blade as set forth in claim 1 wherein said lever defines transversely spaced arms, links connected to said arms, bellcranks connected to said links and said valves to operate said valves when said lever is operated.

5. A hydraulic means for operating a bulldozer blade as set forth in claim 1 including means defining said first pivotal axis for said control lever and means defining said second pivotal axis for said control lever, said control valves defining reciprocating axes parallel with said second axis, means connecting said lever with said valves to thereby reciprocally move said valves in the same direction when said lever is pivoted about said first axis.

6. A hydraulic means for operating a bulldozer blade as set forth in claim 1 wherein said control valves include reciprocating spool valves.

7. A hydraulic means for operating a bulldozer blade as set forth in claim 1 including bracket means defining the second pivotal axis of rotation, a clevis means on said bracket means defining the first pivotal axis of rotation of said lever, said control valves including a bellcrank connected between each of said control valves and said control lever, spring means in each of said valves for returning each of said valves to a neutral position to thereby return said control lever to a normally neutral position.

8. A hydraulic means for operating a bulldozer blade as set forth in claim 1 wherein a first control valve and a second control valves include a linkage connecting said control valve to said lever, said control lever selectively pivoting about the first and second axis of rotation to simultaneously actuate said valves for pitching and tilting said bulldozer blade.

9. A hydraulic means for operating a bulldozer blade as set forth in including, 1 including a bearing bracket supported on said vehicle, a clevis including a shank pivotally mounted in said bearing bracket defining the second axis, means on said lever journaled in said clevis defining the first axis at movement for said control lever, said control lever thereby rotating about the first axis to simultaneously operate said control valves to pitch said blade and about said second axis of rotation to differentially operate said control valves to tilt said blade.

10. A hydraulic means for operating a bulldozer blade as set forth in claim 1 including a frame pivotally supporting said strut and said pusharm.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,700,044 Dated October 24, 1972

Inventor(s) David A. Berg

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, Claim 9, line 4, after "in" insert --claim 1--;

line 4, cancel "1 including".

Signed and sealed this 8th day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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USCOMM-DC 60376-P69
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