HYDRAULIC MOTOR GRADER BLADE LIFT, CENTERSHIFT CONTROL

Inventors: Harold M. Johnson; Russell D. Page, both of Decatur, Ill.

Assignee: Caterpillar Tractor Co., Peoria, Ill.

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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Stephen C. Pellegrino
Attorney—Fryer, Tjensvold, Felix, Phillips & Lempio

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ABSTRACT

An all-hydraulic control including two sets of vertically extending and horizontally extending jacks interconnected in pairs by bell cranks pivoted on opposite sides of the main frame of a motor grader, the horizontal jacks being coupled to the main frame and the vertical jacks being coupled to the blade support circle carrying drawbar of the grader, whereby correlated actuation of the jacks controls the elevation of the blade. The lift linkage is complemented by a centershift control linkage which includes a pivotal member rotatable on the frame about a vertical axis, a jack acting between the frame and the pivotal member, and a jack acting between the pivotal member and the drawbar. The centershift control jacks are actuated individually or jointly in combination with the lift linkage to provide minor or extreme lateral blade adjustments. The overall linkage accomplishes complete control conveniently while maintaining excellent operator visibility about the blade and forward part of the vehicle.

9 Claims, 6 Drawing Figures
HYDRAULIC MOTOR GRADER BLADE LIFT, CENTERSHIFT CONTROL

BACKGROUND OF THE INVENTION

All-hydraulic control of the blade of a modern heavy duty motor grader is desirable in order to accommodate the high forces or torque loads encountered therewith as well as to facilitate the expedient control of the heavy duty control functions. Heretofore hydraulic blade control systems have generally employed a rotary yoke arrangement about the forward main frame to allow full blade positioning through a series of hydraulic jacks. A master/slave cylinder arrangement is employed to actuate a pair of lock pins engaging the yoke, which permits selective positioning of the yoke and a lift jack support saddle mounted thereon. The complexity and bulkiness of such lock pin rotating saddle structures have excessively obstructed good operator visibility required around the blade and forward part of the machine for accurate and safe grading operations.

SUMMARY OF THE INVENTION

The general object of the present invention is to provide a compact all-hydraulic linkage arrangement for accomplishing effective, remote positioning of a motor grader blade with minimum obstruction of operator visibility in critical work areas about the blade and forward end of the machine.

In the accomplishment of the foregoing and other objects and advantages, the blade control linkage arrangement of the present invention generally includes a pair of bell cranks carried on opposite sides of the main frame of a motor grader and pivotal about a transverse axis. A pair of horizontal control jacks are coupled between the frame and depending arms of the cranks to control their rotational positions, and a pair of vertical lift jacks supported on horizontally projecting arms of the cranks are coupled to the blade support circle carrying drawbar of the vehicle.

The control arrangement also includes a centershift control linkage which comprises a pivotal member mounted on the frame for rotation about a vertical axis, a horizontal jack coupled between the frame and pivotal member to determine its rotational position, and a jack angularly depending from the pivotal member and coupled to one side of the drawbar.

The vertical lift jacks normally control blade elevation and, when correlative assisted by the horizontal jacks of the lift linkage and jacks of the centershift linkage, also afford extreme lateral and vertical positioning of the blade.

In one embodiment of the control linkage arrangement, the bell cranks of the lift linkage are directly pivotally connected to the main frame and the horizontal jacks are directly coupled to the frame. In addition, the pivotal member of the centershift linkage comprises a bell crank having vertically spaced angularly related arms rotatably mounted on the frame for rotation about a vertical axis. The horizontal jack of this linkage is coupled to the upper arm of the crank, and the angular jack depends from the second arm thereof.

In another embodiment of the control linkage arrangement, the pivotal member of the centershift linkage comprises a laterally adjustable saddle pivotally secured to the main frame for rotation about a vertical axis. The cranks of the lift linkage are pivotally connected to the saddle and the horizontal jacks are directly coupled thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a motor grader embodying a hydraulic blade lift and centershift control linkage arrangement in accordance with the present invention.

FIG. 2 is a schematic hydraulic circuit diagram of an integrated control system employed with the linkage arrangement.

FIG. 3 is a fragmentary plan view of the linkage arrangement of FIG. 1.

FIG. 4 is a front elevational view of the linkage arrangement depicting the components in one extreme banked blade position.

FIG. 5 is a side perspective view of a modified form of the control linkage arrangement.

FIG. 6 is a bottom perspective view of the embodiment of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to FIG. 1 in detail, there is shown a motor grader 11 including a front main frame 12 with a drawbar 13 connected to the forward end of the frame by means of a universal joint 14 and extending rearwardly therefrom. A support circle 16 carrying a grading blade 17 is attached to the drawbar in a conventional manner.

In order to facilitate remote positioning of the blade 17 with convenient direct hydraulic adjustment, an all-hydraulic blade lift and centershift control linkage arrangement in accordance with the present invention is coupled to the drawbar 13 to selectively control the positioning of the blade 17.

More particularly, with reference to both FIGS. 1 and 3, the linkage arrangement includes a lift linkage comprising a pair of bell cranks 18 and 19 pivotally mounted on opposite sides of main frame 12 for rotation about a transverse axis. In the present embodiment, cranks 18 and 19 are pivotally mounted on stub shafts 21 and 22 transversely projecting from the opposite sides of the frame at a point rearwardly of the drawbar, which point is the juncture of a pair of tubularly rearwardly and downwardly extending frame beams 23 and 24.

A pair of horizontal hydraulic jacks 26 and 27 are coupled between the frame and depending arms 28 and 29 of cranks 18 and 19. The jacks are preferentially disposed between the beams 23 and 24 with the head ends of the jacks pivotally connected thereto, and the rod ends pivotally connected to the crank arms 28 and 29. The jacks are thus conceivably from the operator's line-of-sight and do not obstruct vision of critical work areas.

A pair of vertical hydraulic jacks 31 and 32 are supported on forwardly and transversely outwardly extending arms 33 and 34 of cranks 18 and 19, and coupled to transversely spaced points of a cross member 36 of the drawbar 13. In this regard, the jacks are pivotally connected to the crank arms 33 and 34 for movement about longitudinal axes as indicated at 42 and 43. In this manner, the vertical jacks are universally movable with respect to the crank arms. The rod ends of the jacks are then connected to the drawbar cross member 36 by means of universal ball joints 44 and 46.

The linkage arrangement also includes a centershift control linkage which includes a pivotal member mounted on the main frame 12 for rotation about a vertical axis. In the instant embodiment the pivotal member comprises a bell crank 47 having vertically spaced angularly related arms 48 and 49 connected by a pivot shaft 51. The shaft 51 extends vertically through the frame 12 in rotatable relation thereto with the arms 48 and 49 being respectively disposed adjacent the top and bottom surfaces of the frame.

A horizontal jack 52 is coupled between the frame and crank arm 48 to determine the rotational position of the crank. The head end of the jack is pivotally connected to the frame as indicated at 53 for movement about a vertical axis, while the rod end is connected to the crank arm as indicated at 54 for movement about a vertical axis. As so positioned substantially flush with, and within the transverse confines of the frame, the jack is unobstructing to the operator's view of the blade and forward part of the machine.

The centershift control linkage further includes a hydraulic jack 56 coupled between the crank arm 49 and the drawbar cross member 36 to one side of the longitudinal center line of the drawbar 13. The head and rod ends of the jack are preferably connected by means of ball joints 57 and 58 to the crank arm and drawbar cross member, respectively.
3,677,350

In order to facilitate integrated hydraulic control of the link-age arrangement structurally described hereinbefore, a substantially 87 and 88, an hydraulic and control system may be incorporated therewith as depicted by the hydraulic circuit diagram of FIG. 2. As shown therein, a pressure source 59, such as the hydraulic pumps of the grader 11, is coupled to right and left hand manifold and relief valves 61 and 62 and to a circle drive 63 coupled to hydraulic drive means (not shown) coupled to the transverse crank circle.

The manifold and relief valve 61 distributes the source pressure to manually controlled right hand lift position jack, right hand blade lift jack, and centershift position jack controls 64, 66, and 67. The manifold and relief valve 62 similarly distributes source pressure to left hand lift position jack, lift hand blade lift jack, and centershift jack controls 68, 69 and 71.

The controls 64, 66, and 67 are associated with lock valves 72, 73, and 74 for controlling hydraulic fluid flow to and from the head and rod ends of the cylinders of jacks 26, 31, and 52 respectively. Similarly, the controls 68, 69, and 71 are associated with lock valves 76, 77, and 78 for controlling hydraulic fluid flow to and from the head and rod ends of the cylinders of jacks 27, 32 and 56. Thus, by manual manipulation of the controls, the jacks of the linkage may be individually extended or retracted to substantially any desired positions and locked therein to obtain a multitude of blade positions.

Controlled actuation of the right and left hand lift position jacks 26 and 27 and lift jacks 31 and 32 effects numerous positions and orientations of drawbar 13 corresponding to a variety of elevations, tilts, and banks of the blade 17. Controlled actuation of the centershift position jack 52 and center jack 56 effect minor lateral adjustments of the blade. In addition, extreme lateral blade adjustments are facilitated by correlated actuations of the centershift control linkage and lift control linkage jacks.

For example, when an extreme left bank blade position is desired as illustrated in FIG. 4, right hand lift position jack 26, left hand lift jack 32, and centershift position jack 52, left hand lift position jack 27, right hand lift jack 31, and centershift jack 56 are extended to provide the needed force and leverage to satisfactorily obtain and hold such extended blade position during operations. Conversely, when an extreme right bank blade position is desired, the foregoing retracted and extended conditions of the respective jacks are reversed.

It is of importance to note that most movement of the linkage components is in a longitudinal plane in line with the frame, whereby visibility of critical work areas about the blade and forward part of the machine is substantially unimpaired.

Referring now to FIGS. 5 and 6, there is shown an alternative embodiment of control linkage arrangement which affords effective operational control, but obviates operator visibility slightly more compared to the embodiment hereinbefore described. In accordance with the alternative embodiment, the pivotal member of the centershift control linkage comprises a laterally adjustable sliding saddle or yoke 79. The yoke includes a web 81 with right-angularly depending transversely spaced side legs 82 and 83 at the opposite ends thereof, and a tongue 84 bridging the side legs and projecting longitudinally forward therefrom in spaced parallel relation to the web.

The yoke 79 encompasses the main frame 12 with the side legs transversely spaced therefrom, and the end of the tongue is pivotally connected by a pin 86 to the bottom of the frame for rotation about a vertical axis. In this manner, the yoke is removably laterally pivotal with respect to the frame.

A pair of bell cranks 18 and 19 are pivotally connected to the side legs 82 and 83 of yoke 79 by means of transversely projecting stub shafts 21 and 22. Horizontal lift position jacks 26 and 27 have their head ends pivotally connected to the yoke adjacent the end of tongue 84, as by means of transverse pins 87 and 88, and their rod ends pivotally connected to depending arms 28 and 29' of the cranks for rotation about transverse axes, as indicated at 89 and 91.

A pair of vertical lift jacks 31 and 32' are coupled between rearwardly projecting arms 33 and 34 of cranks 18' and 19' and transversely spaced points of drawbar cross member 36. More particularly, the head ends of jacks 31 and 32' are universally connected by ball joints 92 and 93 to crank arms 33' and 34', while the rod ends are connected to the cross member by means of joints 44' and 46'.

The yoke 79 is selectively sharable transversely of the frame 12 by means of a horizontal centershift position control jack 52'. The head end of the jack is mounted to the frame for pivotal movement about a vertical axis by means of a trunnion 94. The rod end of the jack projects transversely of the frame and is pivotally connected to the end of the yoke web 81 for movement about a vertical axis, as indicated at 96.

A centershift jack 56' depends angularly from yoke 79 and is coupled to the drawbar cross member 36 to one side of the longitudinal center line of drawbar 13. More particularly, the head end of the jack 56' is pivotally connected to a clevis bracket 97 for movement about a horizontal axis at 98, and the clevis bracket is pivotally connected to the underside of yoke tongue 84 by means of a vertical pivot pin 99. A universal connection of the head end of the jack to the yoke is thereby obtained. The rod end of jack 56' is connected by means of a ball joint 101 to the drawbar cross member 36.

It will be thus appreciated that the linkage arrangement of FIGS. 5 and 6 operates to adjust the position of the blade 17 by controlling the position and orientation of drawbar 13 in a manner analogous to that hereinbefore described with respect to the embodiment of FIGS. 1-4. In this regard, the components designated by primed reference numerals perform analogous functions as those designated by like unprimed numerals in the embodiment of FIGS. 1-4.

Although the invention has been hereinbefore described and illustrated in the accompanying drawings with respect to several specific embodiments, it will be appreciated that various modifications and changes may be made therein without departing from the true spirit and scope of the invention, and thus it is not intended to limit the invention except by the terms of the appended claims.

What is claimed is:

1. In a motor grader including a main frame and a drawbar forwardly universally connected thereto, said drawbar having a blade carrying support circle coupled thereto at a position rearwards spaced from the universal connection to the frame, a hydraulic blade lift and centershift control arrangement comprising first and second bell cranks mounted on opposite sides of said frame for pivotally movement about a horizontal transverse axis, said bell cranks each having angularly related horizontal and vertical arms, first and second horizontally disposed hydraulic jacks coupled between said frame and vertical arms of said cranks, third and fourth vertically disposed hydraulic jacks coupled between said horizontal arms of said cranks and transversely spaced points of said drawbar, a pivotal member mounted on said frame for movement about a vertical axis, a fifth hydraulic jack coupled between said frame and pivotal member for determining the rotational position of the latter, and a sixth hydraulic jack depending from said pivotal member and coupled to said drawbar at a position transversely spaced to one side of the longitudinal center line thereof, whereby said jacks may be correspondingly actuated to adjust the position and orientation of said drawbar and thereby control the elevation and lateral position of said blade.

2. The combination of claim 1, further defined by said bell cranks being directly pivotally connected to opposite sides of said frame, said first and second jacks being directly pivotally connected to said frame at a position rearwards of said cranks for movement about a transverse axis and pivotally connected to said vertical arms of said cranks for movement about transverse axes, said third and fourth jacks being coupled to said horizontal arms of said cranks for universal movement relative thereto and coupled to said drawbar for universal movement relative thereto, sixth jack being pivotally connected to said pivotal member for universal movement relative thereto and coupled to said drawbar for universal movement relative thereto.
3. The combination of claim 2, further defined by said pivotal member comprising a third bell crank having a pair of angularly related vertically spaced arms at opposite ends of a pivot shaft, said shaft extending vertically through said frame in rotatable relation thereto with said arms respectively disposed adjacent the top and bottom surfaces of said frame, said fifth jack being pivotally connected to the top surface of said frame for movement about a vertical axis and pivotally connected to the top arm of said third crank for movement about a vertical axis, said sixth jack being coupled to the bottom arm of said third crank.

4. The combination of claim 3, further defined by clevis brackets pivotally connected to said horizontal arms of said first and second cranks for movement about longitudinal axes, said third and fourth jacks pivotally connected to said clevis brackets for movement about transverse axes, and ball joints respectively connecting said third and fourth jacks to said drawbar and said sixth jack to said bottom arm of said third crank and to said drawbar.

5. The combination of claim 1, further defined by said pivotal member comprising a saddle yoke having a web transversely interconnecting parallel spaced side legs and a tongue bridging said legs and projecting longitudinally therefrom in parallel spaced relation to said web, said yoke encompassing said frame with said side legs in transversely spaced relation thereto, said tongue pivotally connected at its end to the bottom of said frame for movement about a vertical axis to thereby render said yoke laterally shiftable relative to said frame, said first and second cranks pivotally connected to said side legs of said yoke for movement about transverse axes, said first and second jacks coupled between the end of said tongue and said vertical arms of said cranks, and said sixth jack depending from said tongue of said yoke.

6. The combination of claim 5, further defined by said third and fourth jacks being coupled to said horizontal arms of said cranks for universal movement relative thereto and coupled to said drawbar for universal movement relative thereto, said fifth jack pivotally mounted on the top of said frame for movement about a vertical axis, said fifth jack disposed transversely of said frame and pivotally connected to said web of said yoke adjacent one side leg thereof for movement about a vertical axis, said sixth jack being coupled to said tongue of said web for universal movement relative thereto and coupled to said drawbar for universal movement relative thereto.

7. The combination of claim 6, further defined by a clevis bracket pivotally connected to said tongue of said yoke for movement about a vertical axis, said sixth jack pivotally connected to said clevis bracket for movement about a transverse axis, and ball joints respectively connecting said third and fourth jacks to said horizontal arms of said cranks and to said drawbar and connecting said sixth jack to said drawbar.

8. In a motor grader including a main frame and a drawbar forwardly universally connected thereto, said drawbar having a blade carrying support circle coupled thereto at a position rearwardly spaced from the universal connection to the frame, a hydraulic blade centershift control linkage arrangement comprising a pivotal member mounted on said frame for movement about a vertical axis, a first hydraulic jack coupled between said frame and pivotal member for determining the rotational position of the latter, and a second hydraulic jack depending from said pivotal member and coupled to said drawbar at a position transversely spaced to one side of the longitudinal center line thereof, whereby said jacks may be correlativelly actuated to adjust the orientation of said drawbar and thereby control the lateral position of said blade.

9. The combination of claim 8 further defined by said pivotal member comprising a bell crank having a pair of angularly related vertically spaced arms at opposite ends of a pivot shaft, said shaft extending vertically through said frame in rotatable relation thereto with said arms respectively disposed adjacent the top and bottom surfaces of said frame, said first jack being pivotally connected to the top surface of said frame for movement about a vertical axis and pivotally connected to the top arm of said bell crank for movement about a vertical axis, said second jack being coupled to the bottom arm of said bell crank.