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Johnson et al.

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[54] **BLADE LIFT/CENTERSHIFT CONTROLS FOR MOTOR GRADERS**

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[52] **U.S. Cl.** **172/793,** 172/666

[51] **Int. Cl.** **E02f 3/76**

[58] **Field of Search** 172/791–793, 781, 789, 795–797

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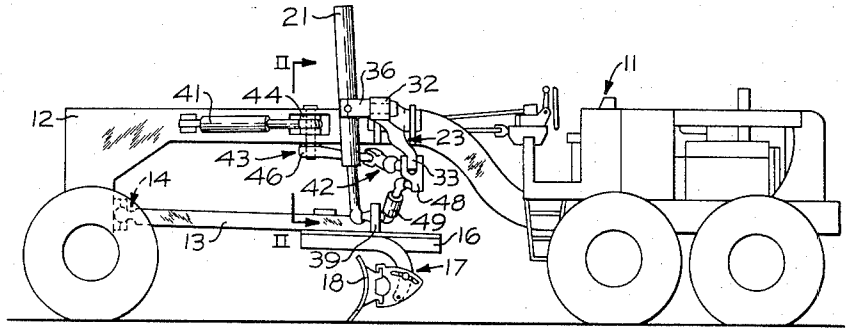
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[57] **ABSTRACT**

Motor grader blade controls having direct hydraulic blade lift and centershift linkage in cooperation with lateral tilt linkage which may be either fully hydraulic or semihydraulic in its actuation. The linkage is such as to present negligible obstruction to operator visibility of the blade.

7 Claims, 6 Drawing Figures



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SHEET 1 OF 3

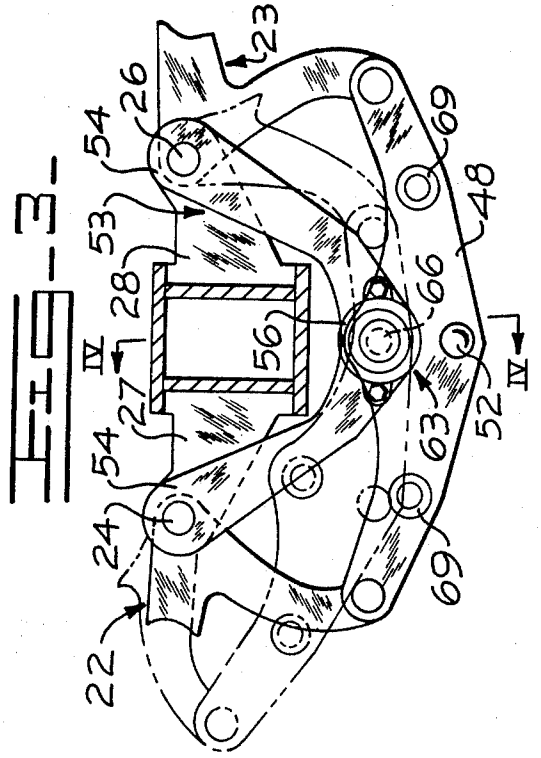


FIG-3-

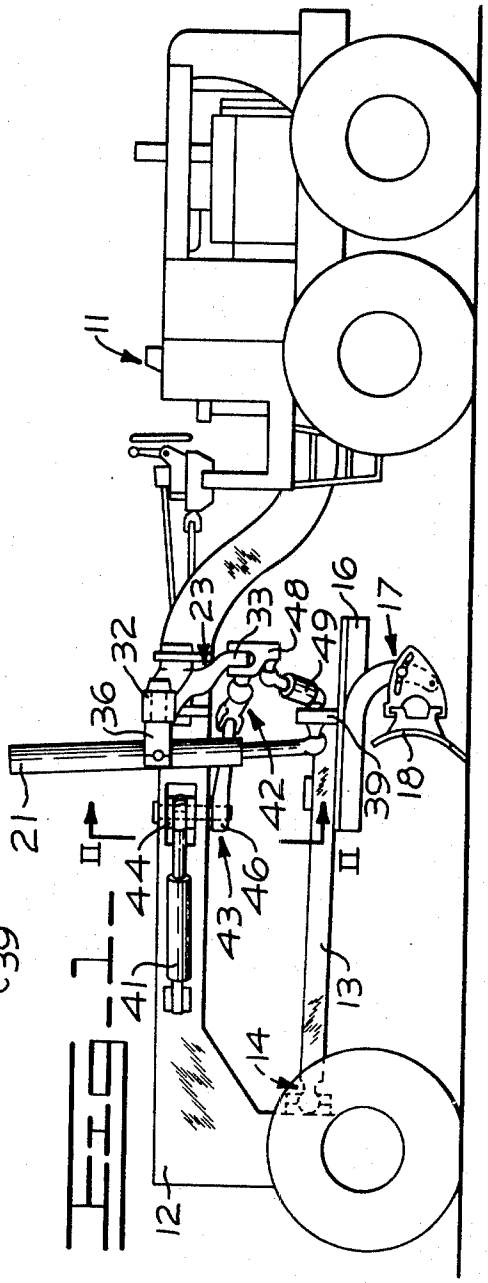


FIG-1-

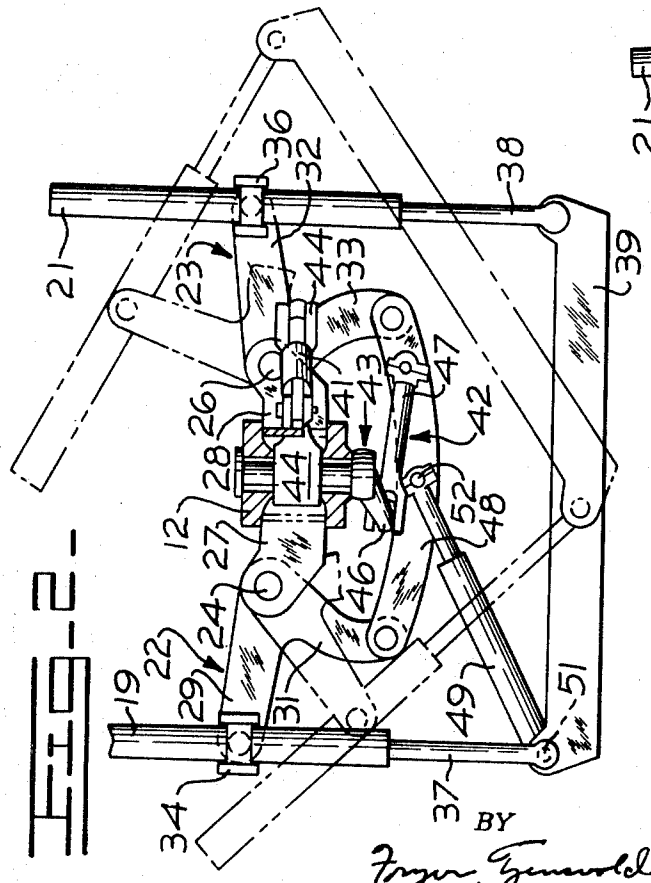


FIG-2-

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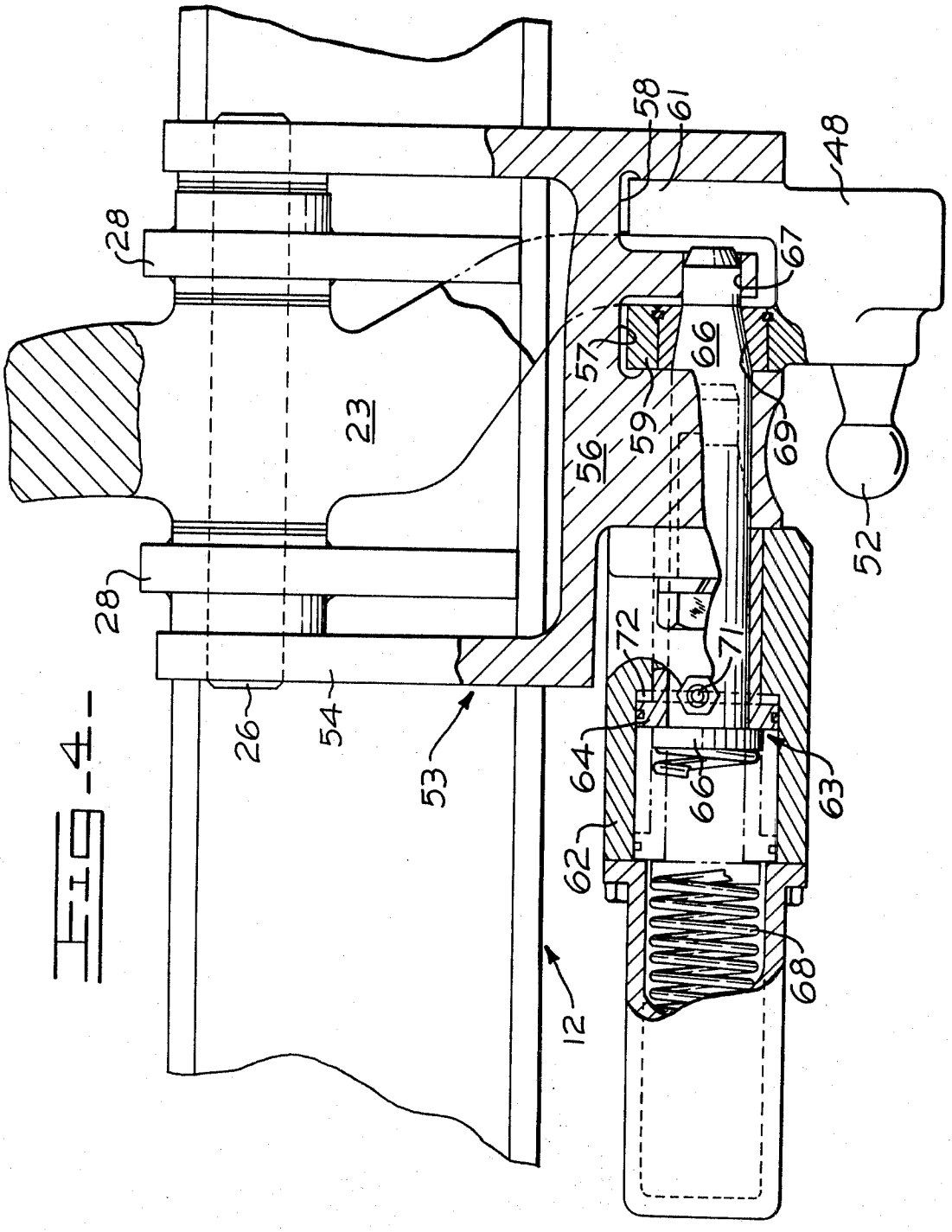


FIG-4-

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Fig-5-

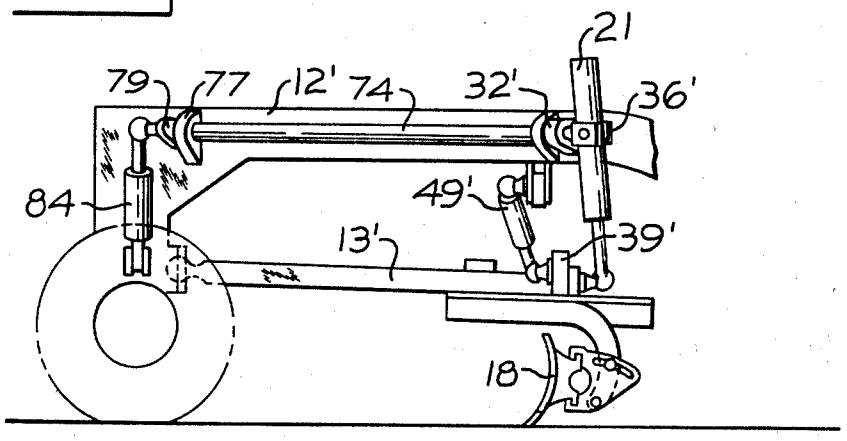
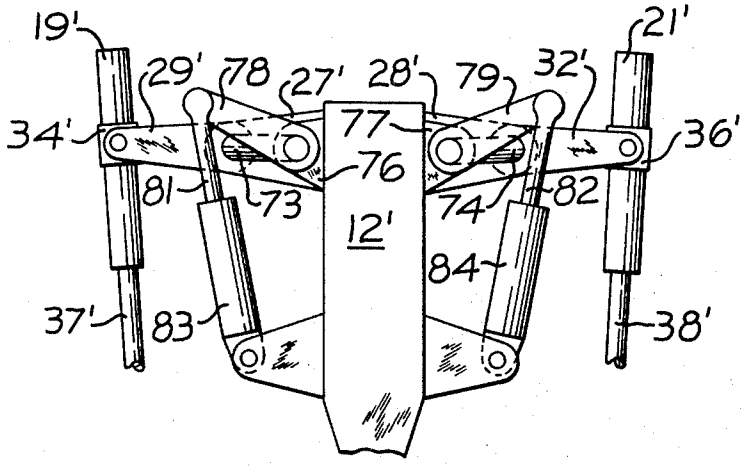


Fig-6-



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BLADE LIFT/CENTERSHIFT CONTROLS FOR MOTOR GRADERS

BACKGROUND OF THE INVENTION

Various mechanically operated blade lift/centershift controls have long been employed with motor graders to facilitate appropriate adjustment of the position of the blade to effect a wide variety of grading operations. However, as machines get bigger, experience has indicated that mechanical transmission of high forces or torque loads for blade control purposes is growing increasingly difficult. For this reason, the current trend has been toward all-hydraulic blade control systems.

However, present hydraulic blade controls typically employ rotary yoke arrangements about the forward main frame including a master-slave cylinder mechanism to actuate 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 is disadvantageous in that operator visibility of the blade is thereby excessively obstructed. In addition, cumbersome release of lock pins and prepositioning of the controls are generally necessary to obtain maximum reach positions with prior art hydraulic blade control systems.

SUMMARY OF THE INVENTION

The general object of the present invention is to provide a relatively compact hydraulic blade lift/centershift control for motor graders which presents little obstruction to operator visibility of the blade. A fully hydraulic centershift lateral tilt linkage may be incorporated in the control to meet the more sophisticated blade positioning needs of large contractors. Alternatively, a substantially more economical hydraulically actuated lock pin arrangement may be employed to provide the less sophisticated centershift positioning functions required by smaller contractors.

In the accomplishment of the foregoing and other objects and advantages, a blade lift/centershift control in accordance with the present invention generally includes a pair of vertically disposed hydraulic lift jacks pivotally connected to a pair of supporting bell cranks for movement about longitudinal and transverse axes, the bell cranks in turn being pivotally mounted for movement about longitudinal axes upon a pair of oppositely laterally projecting brackets secured to the opposite sides of the main frame of a motor grader. The rod ends of the jacks are pivotally connected to oppositely laterally spaced positions of a transverse crossbeam of the grader drawbar. The cranks acting through the jacks and their rods thus swing in transverse vertical planes to adjustably support the drawbar, and therefore the blade circle and moldboard carried thereby.

In addition, means are provided to adjust the pivotal positions of the cranks to obtain extended reach or effectiveness for both lift jacks. Such means may be fully hydraulic or semihydraulic depending on the sophistication of the blade positioning functions required. Finally, the control preferably includes a centershift jack transversely coupled between the frame and drawbar to provide positive side shifting of the drawbar and blade carrying moldboard.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 2 is a sectional view taken at line II—II of FIG. 1.

FIG. 3 is a view similar to FIG. 2, but of a modified form of the control wherein a hydraulically actuated lock pin arrangement is employed to accomplish semihydraulic extended reach positioning of the blade in place of fully hydraulic positioning thereof.

FIG. 4 is a sectional view taken at line IV—IV of FIG. 3 illustrating further details of the lock pin arrangement.

FIG. 5 is a fragmentary side elevational view of a motor grader embodying another modified form of the blade control arranged for fully hydraulic actuation.

FIG. 6 is a fragmentary front elevational view of the control of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring now to FIGS. 1 and 2 in detail, there is shown a motor grader 11 having a main frame 12 and a drawbar 13 with one end connected for universal movement to the forward end of the main frame, as indicated at 14. At the distal end of the drawbar with respect to universal connection 14 there are carried a blade circle 16 and moldboard 17 with its associated blade 18 in the conventional manner. By universally controlling the position of drawbar 13, corresponding lift and centershift control of the blade 18 is obtained.

A fully hydraulic blade lift/centershift control in accordance with the present invention for accomplishing such universal adjustment of drawbar position includes a pair of vertically extending hydraulic lift jacks 19 and 21 under a pair of supporting bell cranks 22 and 23 pivotally carried on longitudinal pins 24 and 26 mounted on oppositely laterally projecting brackets 27 and 28 secured to the opposite sides of the main frame 12.

Bell cranks 22 and 23 respectively include angularly related arms 29, 31 and 32, 33, and U-brackets 34 and 36 are pivotally connected to arms 29 and 32 for movement about longitudinal axes. Brackets 34 and 36 are in turn pivotally connected to the jacks 19 and 21 for movement about transverse axes, and the rods 37 and 38 of jacks 19 and 21 are connected at their ends for pivotal movement about longitudinal axes to the opposite ends of a transverse crossbeam 39 of the drawbar 13.

The drawbar is thus supported by the lift jacks and associated bell cranks, and the cranks swing in vertical transverse planes while the jacks swing in both vertical transverse and vertical longitudinal planes. By adjusting the rotational positions of the cranks and correlatively hydraulically extending and retracting the rods of the hydraulic jacks, a variety of blade lift and centershift positioning functions are obtained.

Fully hydraulic actuation of the cranks 22 and 23 to varied rotational positions for accomplishing the centershift control functions is preferably facilitated by means of a complementing centershift position hydraulic jack 41 and connecting linkage as generally indicated at 42. Linkage 42 includes a bell crank 43 having axially spaced angularly related arms 44 and 46. The crank is journalled in the main frame 12 for rotation

about a vertical axis with the arm 44 projecting through a transverse opening in the frame and the arm 46 disposed subjacent same.

Jack 41 is coupled between the frame and arm 44 to impart rotation to crank 43 in response to hydraulic extension and retraction of the jack. Crank arm 46 is coupled via a link arm 47 to a point adjacent one end of a cross connecting linkage 48 coupled between the ends of arms 31 and 33 of support cranks 22 and 23 to facilitate unitary pivotal movement thereof.

Consequently, responsive to the hydraulically actuated rotation of crank 43, support cranks 22 and 23 are unitarily pivoted to tilt the lift jacks 19 and 21 and drawbar 13 thereby supported, to the right or left depending upon the sense of rotation of crank 43. In this regard, the linkage is shifted from the full line to phantom line position depicted in FIG. 2 upon clockwise rotation of crank 43.

To complete the fully hydraulic blade lift/centershift control of the present invention as embodied in FIGS. 1 and 2, there is provided a centershift hydraulic jack 49 for positive side shifting of the drawbar 13 and blade 18 carried thereby. The head end of jack 49 is coupled by means of a ball joint 51 to one end of drawbar crossbeam 39, while the rod end of the jack is coupled by means of a ball joint 52 to the center of the cross connecting link 48 between support cranks 22 and 23.

The head end of jack 49 may be interchangeably connected to a complementary ball joint at the opposite end of the drawbar crossbeam. In this regard, the jacks 41 and 49, bell crank 43, and interconnecting linkage afford most normal centershift positioning, however if a maximum 90° vertical angle is to be attained the jack 49 must be connected to the end of the crossbeam toward the desired blade position.

Inasmuch as the fully hydraulic centershift linkage arrangement including the jack 41, bell crank 43, and connecting linkage described hereinbefore is relatively extensive and costly, it is sometimes desirable for less sophisticated applications that a simplified less costly arrangement be substituted therefor. In this regard, reference is made to FIGS. 3 and 4 which illustrate a selectively adapted, hydraulically actuated lock pin arrangement for accomplishing most of the normal centershift positioning functions.

The arrangement includes a lock pin support bracket 53 having longitudinally spaced pairs of laterally spaced ears 54 extending upwardly and outwardly from a body 56. The pairs of ears 54 are adapted to engage the brackets 27 and 28 for securance thereto by means of the pins 24 and 26, and thereby support the body 56 subjacent the main frame 12.

The body 56 is formed with longitudinally spaced transversely extending grooves 57 and 58 for slidably receiving spaced apart rail portions 59 and 61 of cross connecting link 48. The housing 62 of a hydraulically actuated locking pin mechanism 63 is secured to the body 56 of bracket 53 subjacent the main frame. A piston 64 is mounted for reciprocation within the housing, and a locking pin 66 coaxially secured to the piston projects exteriorly of the housing into a bore 67 extending through the body 56 in intersecting relation to the grooves 57 and 58. A spring 68 disposed within the housing normally resiliently urges the piston wherein the pin traverses groove 57. The pin also traverses one of a plurality of transversely spaced holes 69 provided through the rail portions 59 and 61 of link 48, thereby locking same in position.

In this manner, the particular hole engaged by the pin determines the position of the link and thus the rotational positions of support cranks 22 and 23. Upon the introduction of hydraulic pressure to an inlet port 71 provided in the housing 62 in communication with a chamber 72 on the opposite side of the piston 64 from spring 68, the piston and pin are hydraulically actuated to a retracted position, as depicted in dashed line in FIG. 4. In this position, the pin is disengaged from any of the holes 69 and the link 48 is thus freed for translational movement.

Upon relaxation of hydraulic pressure, the spring 68 urges the piston and pin towards the extended positions thereof such that any of the holes 69 in registry with bore 67 is engaged by the pin to lock the link 48 in a transverse position determined by the location of the particular engaged hole.

Considering now the manner in which the lock pin arrangement is employed to facilitate lateral adjustment of the blade to extreme side shift positions, assume that the pin 66 is initially engaged with the centermost one of the holes 69 of link 48, as shown in FIG. 3. To effect a lateral blade adjustment it is necessary to rest the blade 18 on the ground, release the lock pin, and preposition the cranks 22 and 23 and link 48 to obtain a maximum side reach condition.

For instance, if it is desired to shift the blade to the far left, as in the phantom line position of FIG. 3, the lift jacks 19 and 21 are initially extended sufficiently to rest blade 18 upon the ground. Locking pin mechanism 63 is hydraulically actuated to retract pin 66 and thereby release link 48 for translational movement. Jack 19 is then fully extended and jack 21 retracted which shifts the entire bell crank linkage to the left, through reaction from the blades and jacks, sufficiently to register the right hand hole 69 of link 48 (as viewed in FIG. 3) with bore 67. The pin 66 is now engaged with this hole by relaxation of hydraulic pressure in the housing 62, thereby locking the link 48 and bell cranks 22 and 23 in the left shifted position. From this position jacks 19 and 21 are respectively retracted and extended to effect the left extended position of the blade 18.

Referring now to FIGS. 5 and 6, there will be seen another modified form of blade lift/centershift control in accordance with the present invention which is arranged for fully hydraulic actuation as in the case of the embodiment of FIGS. 1 and 2. In the instant case, crank arms 29' and 32' are mounted for pivotal movement about longitudinal axes upon oppositely laterally projecting brackets 27' and 28' secured to the opposite sides of the main frame 12'.

U-brackets 34' and 36' are pivotally connected to arms 29' and 32' for movement about longitudinal axes, and the brackets are in turn connected to lift jacks 19' and 21' for pivotal movement about transverse axes. The rods 37' and 38' of jacks 19' and 21' are coupled to the opposite ends of the transverse crossbeam 39' of drawbar 13'. A centershift hydraulic jack 49' is coupled between the frame 12' and one end of crossbeam 39' for positive side shifting of drawbar 13'.

To the extent thus far described, it will be appreciated that the control arrangement of FIGS. 5 and 6 is substantially similar to that of FIGS. 1 and 2. However,

in the present embodiment, fully hydraulic actuation of crank arms 29' and 32' to varied rotational positions is accomplished in a somewhat modified manner.

More particularly, the crank arms 29' and 32' are radially connected to a pair of substantially longitudinal torque tubes 73 and 74 journalled between brackets 27' and 28' and a second set of oppositely laterally projecting brackets 76 and 77 secured to frame 12' at a forwardly displaced location. A pair of radial crank arms 78 and 79 projecting from torque tubes 73 and 74 adjacent brackets 76 and 77 are end connected to the rods 81 and 82 of a pair of vertical hydraulic jacks 83 and 84, the head ends of which are coupled to the bolster of the main frame 12'. Thus, the jacks 83 and 84 may be actuated to control the rotational positions of crank arms 29' and 32' commensurate with a variety of centershift control functions effected by the lift jacks 19' and 21'.

Although the invention has been hereinbefore described and illustrated in the accompanying drawings with respect to several preferred embodiments, it is to be noted 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, a drawbar connected at one end for universal movement to said frame, and a blade carrying moldboard secured to the distal end of said drawbar with respect to its connection to said frame, a blade lift/centershift control comprising a pair of vertically disposed hydraulic lift jacks, a pair of support cranks pivotally mounted for movement about longitudinal axes at oppositely laterally spaced positions of said frame, said cranks having first arms for connection to said lift jacks, means connecting first ends of said lift jacks to said crank arms for pivotal movement about longitudinal and transverse axes relative thereto, means coupling second ends of said lift jacks to oppositely laterally spaced positions of a transverse crossbeam of said drawbar at said distal end thereof, actuatable means including a link between second arms of said cranks respectively and a further connector means to said frame from said link for adjusting the pivotal positions of said support cranks to obtain extended reach positions for said lift jacks, and centershift means including a jack transversely coupled between said actuatable adjusting means and one end of said crossbeam.

2. The combination of claim 1, further defined by said second arms of the support cranks being angularly related to the first arms thereof, and the actuatable adjusting means comprising a bell crank having first and second axially spaced angularly related arms journalled in said frame for rotation about a vertical axis, a positioning hydraulic jack coupled between said frame and said first arm of said bell crank to impart rotation thereto responsive to extension and retraction of said positioning jack, and wherein the link coupled between the ends of said second arms of said support cranks effects unitary pivotal movement thereof, and a link arm coupled between said second arm of said bell crank and one end of said link, whereby hydraulically actuated rotation of said bell crank effects pivotal movement of said support cranks.

3. The combination of claim 1, further defined by the support crank position adjusting means comprising a pair of longitudinal torque tubes journalled for rotation on the opposite sides of said frame, said support cranks connected to said torque tubes for rotation therewith with said arms projecting radially therefrom, a second pair of radial arms connected to said torque tubes for rotation therewith at positions forwardly spaced from said first arms, and a second pair of vertically disposed hydraulic jacks coupled between said frame and said second arms, whereby hydraulically actuated extension and retraction of said second pair of jacks effects pivotal movement of said support cranks.

4. The combination of claim 1, further defined by said second arms of the support cranks being angularly related to the first arms thereof, and the link coupled between the ends of said second arms of said support cranks effecting unitary pivotal movement thereof, and fluid actuated lockpin means carried by said frame for selective locking engagement with any registering one of a plurality of transversely spaced holes defined in said cross connecting link.

5. The combination of claim 4, further defined by said lockpin means comprising a bracket adapted for securance to said frame with a body portion subjacent same, said body portion having at least one transversely extending groove slidably receiving a rail of said cross connecting link, said holes of said link extending through said rail, said body portion having a bore transversely intersecting said groove and registerable with said holes, a piston mounted for reciprocation within said housing, a pin coaxially secured to said piston and projecting exteriorly of said housing through said bore, means spring loading said piston to urge same to an extended position wherein said pin traverses said groove and engages any registering one of said holes, and means for introducing hydraulic pressure to a chamber of said housing in opposition to the force of said spring loading means to actuate said piston to a retracted position wherein said pin is withdrawn from said channel.

6. The combination of claim 2, further defined by said centershift hydraulic jack being coupled between one end of said crossbeam and the center of said cross connecting link.

7. The combination of claim 4, further defined by said centershift hydraulic jack being coupled between one end of said crossbeam and the center of said cross connecting link.

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