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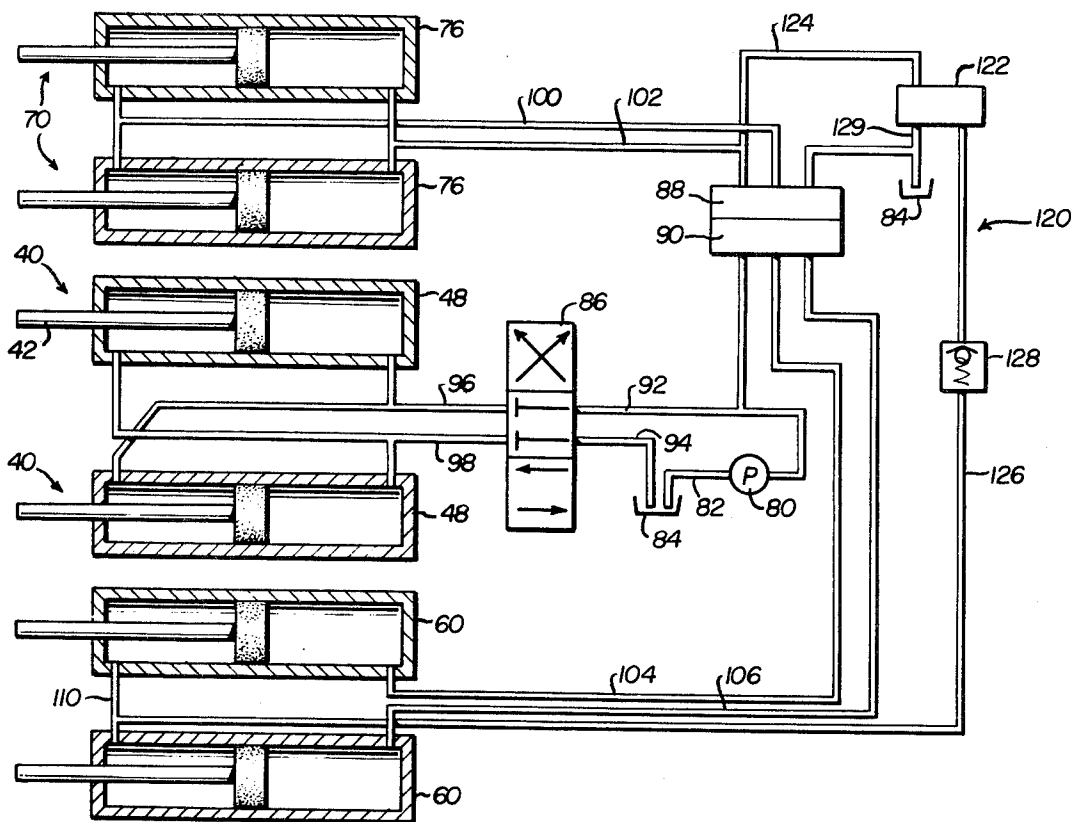
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[54] **HYDRAULIC CONTROL FOR EARTH MOVING
IMPLEMENT**
1 Claim, 5 Drawing Figs.

[52] U.S. Cl. 172/804,
172/663
[51] Int. Cl. E02f 3/76
[50] Field of Search. 172/803,
804, 806, 807, 809

[56] **References Cited**
UNITED STATES PATENTS
3,158,944 12/1964 Rehberg et al. 172/803

ABSTRACT: An earth moving implement including a blade adjustably supported on a U-shaped frame with the free ends of its legs pivotally connected to a vehicle. The control system includes fluid rams for raising and lowering the frame with respect to the vehicle, angling the blade with respect to the U-shaped frame about a vertical axis, and tilting the blade with respect to the frame about a horizontal axis longitudinally of the vehicle. The hydraulic control incorporates an interconnection between the rod ends of the tilt cylinders with means for supplying a constant charging pressure to the rod ends of the tilt cylinders. The charging means may include a connection from the angle cylinders through a regulator valve to the rod ends of the tilt cylinders; or a connection between one end of the lift cylinders through a regulator valve to the rod end of the tilt cylinder; or a connection between the conventional pump of the transmission hydraulic system of the vehicle, or a separate pump connected to the rod ends of the tilt cylinder, all alternates.



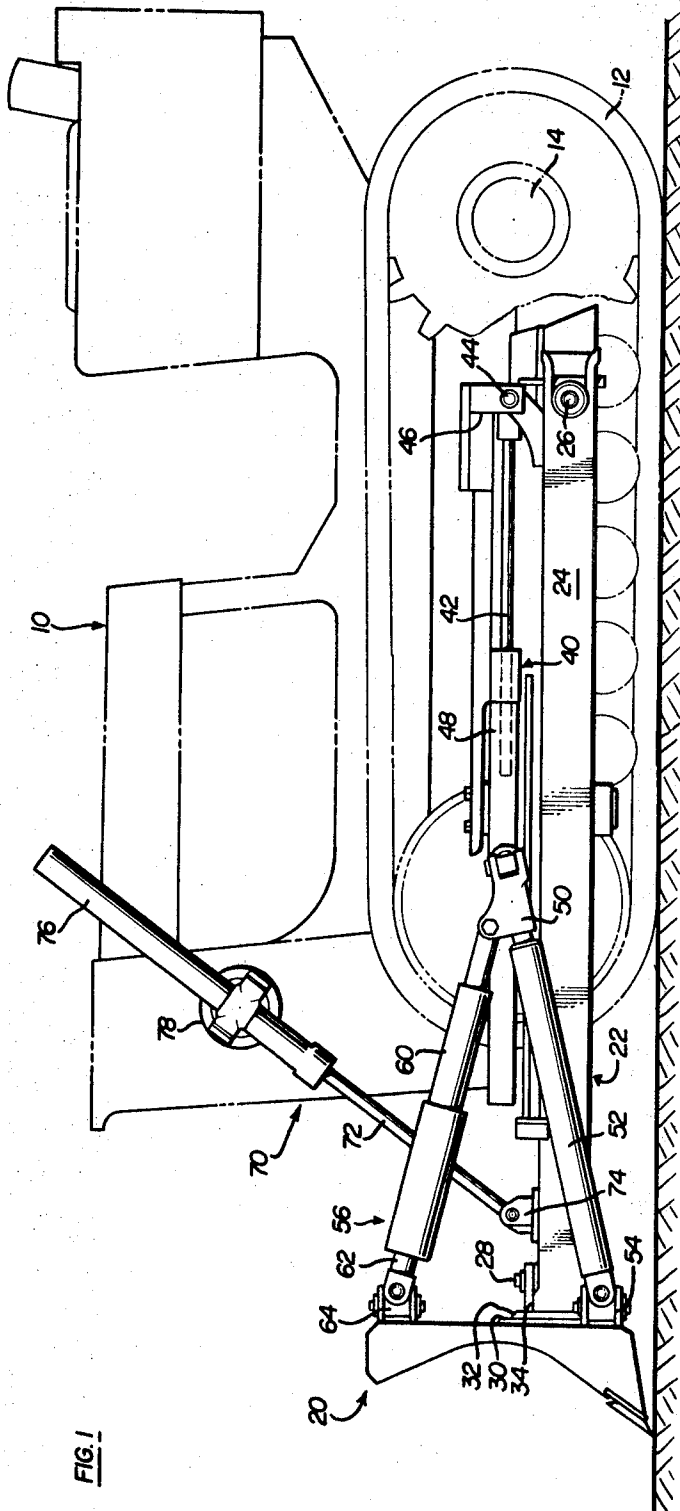


FIG. 1

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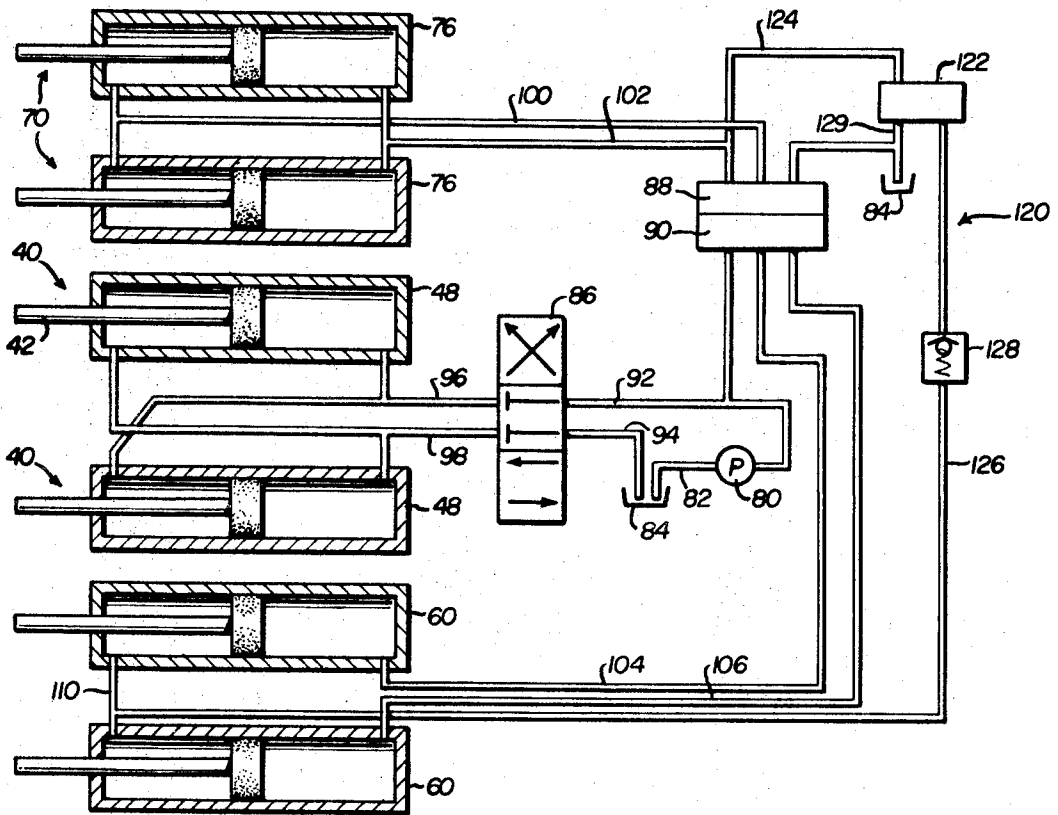


FIG. 2

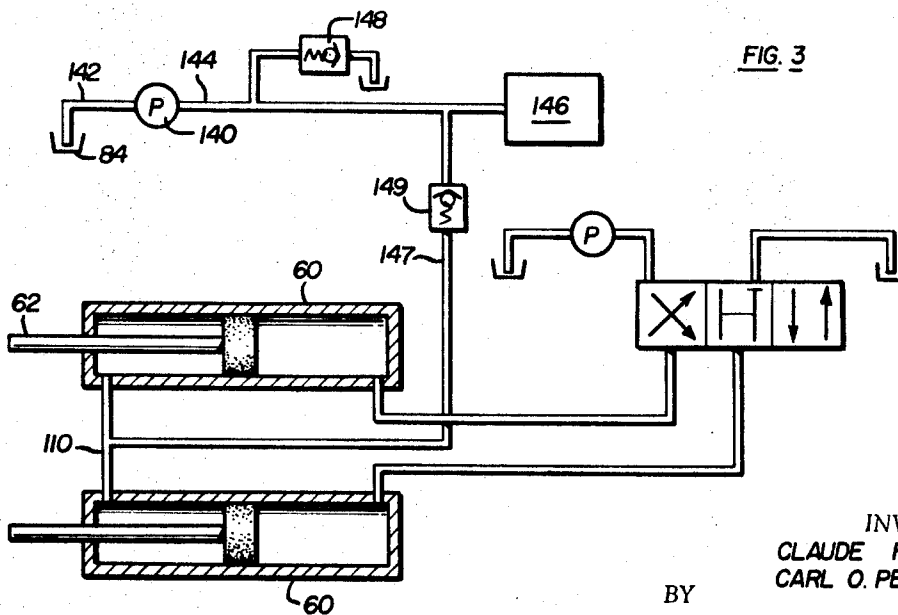
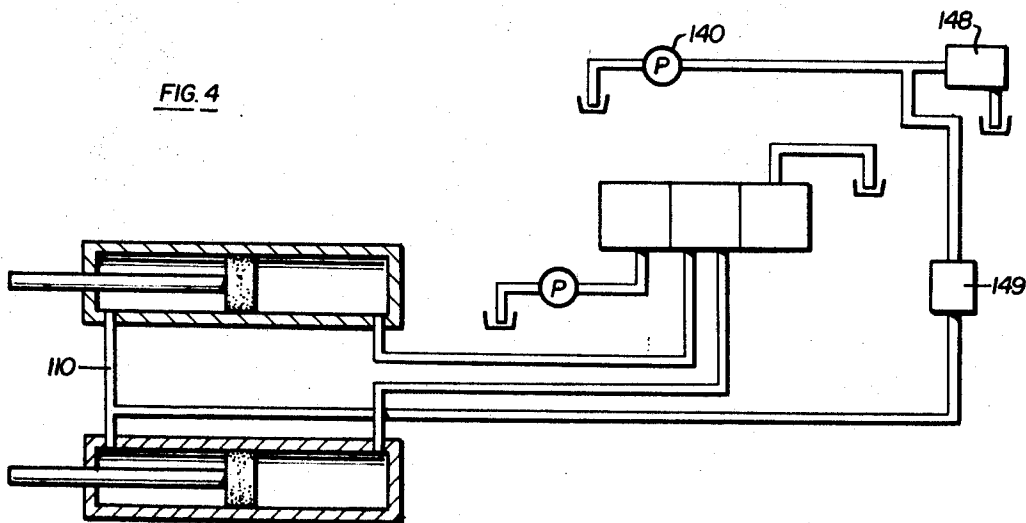
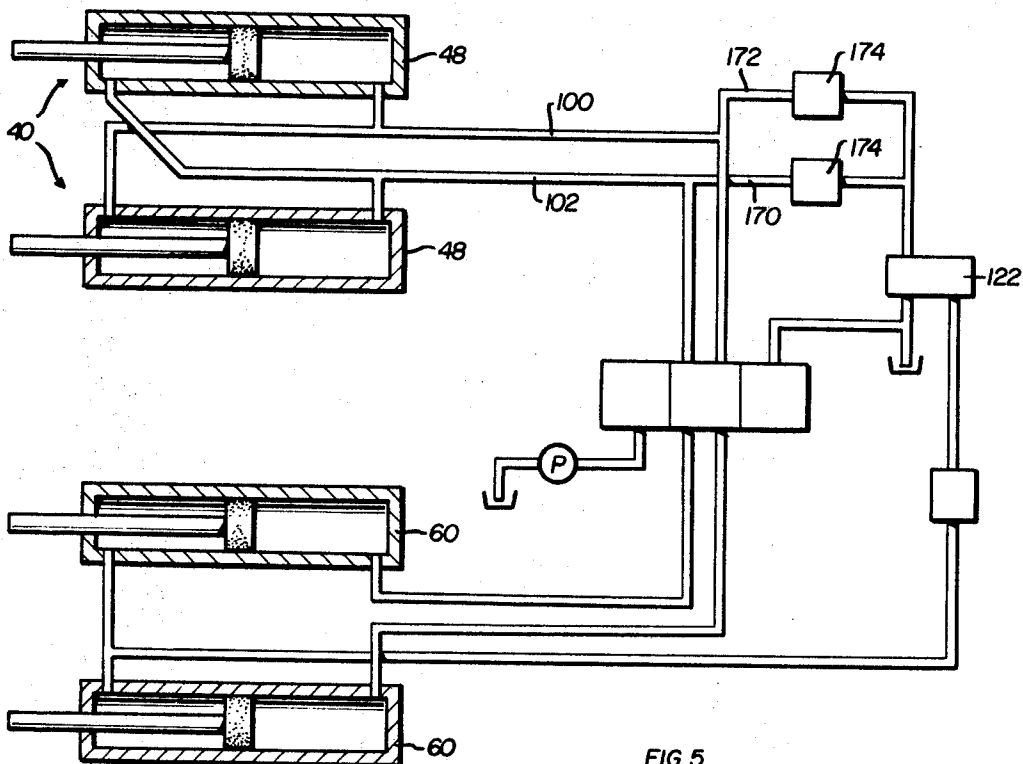


FIG. 3

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HYDRAULIC CONTROL FOR EARTH MOVING IMPLEMENT

BACKGROUND OF THE INVENTION

The present invention relates generally to earth moving implements and more particularly to an improved control system for a dozer blade supported on a vehicle.

In the construction and operation of earth moving implements, such as those used for moving dirt and grading roads, it has become customary to mount a scraper blade in a manner allowing considerable relative movement between the blade and the vehicle. Thus, in most commercial vehicles, the blade is mounted on the frame which is adapted to be raised and lowered with respect to the vehicle. This is normally accomplished by supporting the frame on transversely extending pivot axes on the opposite sides of the vehicle with hydraulic lift cylinders or rams interposed between the vehicle and the frame.

Also, in most commercial vehicles of this type presently available, means are provided for angling the blade with respect to the normal transverse position at the forward end of the vehicle. This is normally accomplished by pivoting the blade on a vertical axis of the frame having one end pivotally supported on the vehicle. Angle cylinders are interposed between the frame and the blade to accommodate pivotal movement about the above-mentioned vertical axis.

Further, in some commercial implements of this type, it has been found desirable to provide a method of tilting the blade with respect to a horizontal axis extending longitudinally of the vehicle. Again, some prior art type of bulldozer constructions incorporate hydraulic means for changing the angular disposition of the cutting edge of the blade relative to the transverse axis of the vehicle, such as the type shown in U.S. Pat. No. 2,681,518, issued to C.C. Troop.

SUMMARY OF THE INVENTION

The present invention provides an improved hydraulic control system for controlling the flow of fluid to, from and between the various cylinders normally incorporated in a bulldozer construction which is capable of having its blade raised and lowered with respect to the vehicle, angled with respect to the longitudinal axis of the vehicle and tilted with respect to the longitudinal axis of the vehicle.

The latter is accomplished by providing a control system in which the forward ends of a pair of tilt cylinder assemblies are interconnected by a single conduit and in which normally equal pressure is at all times maintained in the conduits to insure that any leakage past the piston rods of the tilt cylinders will immediately and automatically be replaced. The control system of the present invention also contemplates to normally maintain the dozer blade in a level position at all times by maintaining a positive pressure on the rod ends of the pistons slidably disposed in the cylinders of the tilt cylinder assemblies.

Thus, the primary object of the present invention is to provide an improved hydraulic control system for cylinder assemblies normally associated with a scraper blade of an earth moving implement.

Another object is to provide a control system which automatically maintains a positive pressure in the forward ends of tilt cylinders normally associated with a blade pivotally mounted upon a supporting vehicle.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1, is a side elevational view of one type of earth moving implement which may be modified to incorporate the control system of the present invention;

FIG. 2 is a schematic illustration of a hydraulic control system constructed in accordance with the preferred embodiment of the present invention;

FIG. 3 is a view similar to FIG. 2 showing a modification of the control system of the present invention;

FIG. 4 is a view similar to FIG. 2 showing a further modified control system of the present invention; and

FIG. 5 is still another modification of the control system of the present invention.

DETAILED DESCRIPTION

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring in greater detail to the drawings, the invention is illustratively shown as being applied to an earth moving implement or dozer which includes a crawler tractor 10 having ground engaging means 12 (only one being shown) on opposite sides thereof supported on transversely extending axles 14. The dozer 10 further includes a scraper blade 20 supported adjacent the forward end of the tractor by a substantially U-shaped frame 22 having legs 24 pivotally supported at 26 to the main frame of the implement or vehicle 10.

The blade 20 is pivotally supported on a pin 28 defining a vertical axis adjacent the forwardmost end of the U-shaped frame or beam 22. The connection between the vertical axis defined by the pin 28 and the blade 20 further includes means for pivotally supporting the blade for tilting movement about a horizontal axis extending longitudinally of the tractor or implement 10. For this purpose, a ring 30 is fixedly secured to the rear surface of the blade 20 which cooperates with an integral plate 32 having spaced legs 34 extending rearwardly and defining a bifurcated bracket which is pivotally attached to the pin 28. Since the particular pivot connection between the blade and the U-shaped frame as well as the between frame and the tractor forms no part of the present invention no further detailed description thereof will be presented at this time. However, for a further detailed description of the frame and blade connections, reference may be had to U.S. Pat. No. 2,943,407 issued to E.B. Long on July 5, 1960 and assigned to the assignee of the present application.

As was indicated hereinabove, the blade 20 is adapted to be raised and lowered with respect to the tractor 10, pivoted about a horizontal transverse axis defined by the pivot 26 to change the angle between a transverse plane defined by the tractor and the forward surface of the blade; and to pivot about a longitudinal horizontal axis of the tractor or vehicle 10. The movement of the blade in the various directions is accomplished by a plurality of fluid rams having cylinders and piston rods slidable within the cylinders. Each degree of movement is accomplished by a pair of cooperating cylinders. However, since the cylinders on opposite sides of the longitudinal center of the vehicle are duplicates, only one side has been shown in detail. If a further detailed description of the cylinder assemblies and the interconnection between the cylinder assemblies and the frame and the blade is desired, reference may again be had to the above-mentioned patent.

The means for changing the angle of the blade with respect to the longitudinal axis of the vehicle or tractor 10 includes a pair of angle cylinder assemblies or fluid rams 40 each having a piston rod 42 connected by a pin 44 to a bracket 46 supported on the vehicle frame. The cylinder 48 of the assembly 40 has a bracket 50 connected thereto, for a purpose which will become apparent hereinafter.

The brackets 50 are connected through fixed length struts 52 to the lower outermost edges of the blade 20 by a universal connection 54. The brackets 50 are likewise connected to the

upper outer corners of the blade by tilt cylinder assemblies or fluid rams 56 which include a cylinder 60 and a piston rod 62 universally connected at 64 to the upper edge of the blade 20. The cylinder assemblies 56 are utilized for tilting the blade about the longitudinal axis of the tractor, as will become apparent hereinafter.

The means for raising and lowering the blade with respect to the vehicle 10 includes lift cylinder assemblies or fluid rams 70 having piston rods 72 connected by a bracket 74 to the right portion of the U-shaped frame 22. The cylinders 76 of the cylinder assemblies are respectively pivotally mounted in trunnions 78 fixedly secured to opposite sides of the tractor 10.

The hydraulic control circuit of the present invention is illustrated in more detail in FIG. 2 and includes a pressured fluid source, such as a pump 80, connected by conduit 82 to a fluid reservoir 84 for selectively supplying pressured fluid to control valve means which are illustratively shown as three manually controlled three-way valves 86, 88 and 90. The control valve 86 is connected through conduit 92 to the pressured fluid source and through conduit 94 to the fluid reservoir or drain 84. The two outlets of the three-way valve 86 are connected through conduits 96 and 98 to the respective opposite ends of the cylinders 48 forming part of the angle cylinder assemblies 40. Thus, pressured fluid supplied through line 96 will extend one piston rod 42 while simultaneously retracting the other piston rod 42.

Pressured fluid is also supplied through control valve 88 and conduits 100 and 102 to the respective opposite ends of the cylinders 76, forming part of the lift ram assemblies 70. Of course, an inspection of the circuit indicates that the two piston rods 72 of the left ram assemblies 70 are simultaneously extended and retracted.

Pressured fluid is selectively supplied to the head ends of the respective tilt cylinders 60 forming part of the tilt cylinder assemblies 56 by conduits 104 and 106 leading from the three-way valve 90 to the respective rod ends of the cylinders 60. The rod ends of the two cylinders 60, forming part of the fluid ram or tilt cylinder assemblies 56, are cross connected by a conduit 110 so that pressured fluid delivered to either of the piston ends of the cylinders will move the piston within the associated cylinder and therefore displace fluid from the opposite side of this piston to the rod end of the remaining cylinder thereby simultaneously operating the other piston in the opposite direction.

According to the present invention, means are provided for simultaneously maintaining a predetermined pressure in the rod ends of each of the tilt cylinders. This particular feature is of extreme importance in producing a satisfactory control system for a dozer of present day construction.

In the preferred embodiment illustrated in FIG. 2, the pressuring means or charging pressure mechanism 120 includes a pressure reducing or regulating valve means 122 having its inlet port or opening connected through a conduit 124 to the conduit 102 leading to the piston ends of the respective lift cylinders 76. The outlet opening of the pressure regulator valve 122 is connected through a conduit 126 to the conduit 110 interconnecting the rod ends of the tilt cylinders 60. The regulator valve also has a bypass port connected through conduit 129 to reservoir 84. Preferably, a one-way check valve 128 of the conventional type is located in the conduit 126 to prevent any increase in pressure at the outlet port of valve 122 as well as maintain a predetermined pressure within the rod ends of the tilt cylinder assemblies 60. The unnumbered line in FIG. 2, from the valve 88 to the pressure relief valve 122, through line 129 is part of line 129 and is a return line to control valves 88 and 90 for the reservoir 84. The line returns any oil from the cylinder to the reservoir. Further, when the control valves are in the neutral position, pressure from the pump drives fluid through this line into valve 90 and directly into the reservoir 84. The valve 122 may be a commercially available type of direct acting pressure reducing valve manufactured and sold by Fluid Controls, Inc. Mentor, Ohio. Since the valve per se forms no part of the present invention, no detailed description thereof appears to be necessary at this point.

OPERATION

It is believed that the operation of the present invention is readily apparent from the above description. It will be understood that, during normal operation of earth moving implements of this type, the fluid trapped in the piston ends of the lift cylinders 76 will at all times be pressurized by the upwardly directed forces exerted from the ground to the lower edge of the blade. Thus, the pressured fluid in conduit 124 leading to the pressure regulating valve 122 will at all times be sufficient to maintain a constant predetermined charging pressure in the rod ends of the tilt cylinders 60. This positive pressure to the inlet of the pressure regulator valve 122 is sufficient to replace any fluid which may leak past the seals between the piston rods and cylinders of the tilt cylinder assemblies 56. This charging pressure on the rod ends of the tilt cylinders of course maintains the dozer blade in a level position relative to the ground.

FIG. 3 EMBODIMENT

The embodiment illustrated in FIG. 3 is in most respects similar to the hydraulic control circuit disclosed in FIG. 2 with the exception that the charging pressure means or the means for maintaining a charging pressure on the rod end of the tilt cylinders is supplied by conventional hydraulic circuitry normally forming part of the vehicle or tractor to which the dozer blade is attached. Thus, the conventional type of crawler tractor incorporates a hydraulic control system for controlling the shifting of the normal transmission. This control system includes a pressured fluid source which again as in the embodiment described hereinabove incorporates a pump 140 connected to fluid reservoir 84 by a conduit 142 with the outlet of the pump connected through conduit 144 to a conventional transmission control valve 146 which is selectively actuable to supply fluid to the various controlled devices forming part of the transmission. Normally, the conduit 144 has associated therewith a pressure relief valve 148 which maintains the pressure within the conduit at a substantially constant level.

In the embodiment illustrated in FIG. 3, the cross conduit 110 is connected through conduit 147 to the outlet side of the pump 140 with a conventional check valve 149 again forming part of the conduit 147 and which is similar in all respects and purposes to the check valve 128.

Thus, the positive pressure within conduit 144, which is at all times available when the power plant of the vehicle 10 is in operation, will maintain a constant charging pressure on the rod ends of the cylinders 60 for the same purpose and in the same manner as described hereinabove.

EMBODIMENT OF FIGURE 4

The embodiment of FIG. 4 is in all respects similar to that described hereinabove with respect to FIG. 3 with the exception that the pump 140, relief valve 148 and check valve 149 are incorporated as a separate circuit specifically designed for supplying charging pressure to the cross conduit or interconnecting conduit 110.

EMBODIMENT OF FIG. 5

The embodiment of FIG. 5 discloses a further modification of the charging pressure control system for maintaining a predetermined charging pressure in the rod ends of the tilt cylinders 60. In the embodiment illustrated in FIG. 5, the inlet of the pressure regulator valve 122 is connected to the respective conduits 96 and 98 leading to the opposite ends of the angle cylinders 48 forming part of the cylinder assemblies 40. The means for connecting the inlet of the pressure regulating valve 122 to the respective conduits 96 and 98 includes a pair of conduits 170 and 172 each having a conventional check valve 174 incorporated therein with the downstream sides of the check valves connected to the inlet of the regulator valve 122 while the upstream sides are respectively in communication with the conduits 96 and 98.

Of course, in normal operation of a conventional power dozer, one of the conduits 96 and 98 is at all times under considerable pressure due to the forces being applied by the ground being worked to the forward surface of the dozer or scraper blade which in turn will be sufficient to maintain a constant positive charging pressure on the cross connection conduit 110 forming part of the tilt cylinder assemblies.

From the above description it will be appreciated that the present invention provides a simple and efficient system at all times maintaining a positive position of the angle of the blade with respect to the longitudinal axis of the vehicle or implement. The various means for maintaining a positive charging pressure on the rod ends of the tilt cylinders 60 will automatically replace any hydraulic oil which is lost due to leakage. Of course, the positive pressure also maintains a true relationship between the rod ends of the respective cylinders to prevent tilting of the blade and to maintain the blade in a level position at all times.

We claim:

1. In combination with a vehicle having a longitudinal axis, a dozer blade pivotally mounted on said vehicle, tilt rams of the hydraulic piston cylinder type interconnected between the dozer and the blade, with the pistons being connected by rods to the upper edge of the blade, and means for maintaining a predetermined constant fluid pressure in the blade connected rod ends of the tilt rams; and means comprising lifter rams of the hydraulic piston cylinder type, interconnected between the blade and the dozer, whose pistons are connected by rods to the lower edge of the blade whereby fluid in the upper ends of the lifter rams will be pressurized by ground resistance to the lower edge of the blade during dozing, and conduits connecting the upper ends of the lifter rams to the rod ends of the tilt rams, whereby the fluid of the lifter rams pressurized during dozing operations, will pressurize the fluid in the rod ends of the tilt rams, thereby maintaining constant fluid pressure in the blade connected rod ends of the tilt rams and inhibiting tilting of the blade during normal dozing operation.

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