Jan. 2, 1940. L. O. BIRD ET AL 2,185,179

HYDRAULIC CONTROL FOR TRAIL BUILDER

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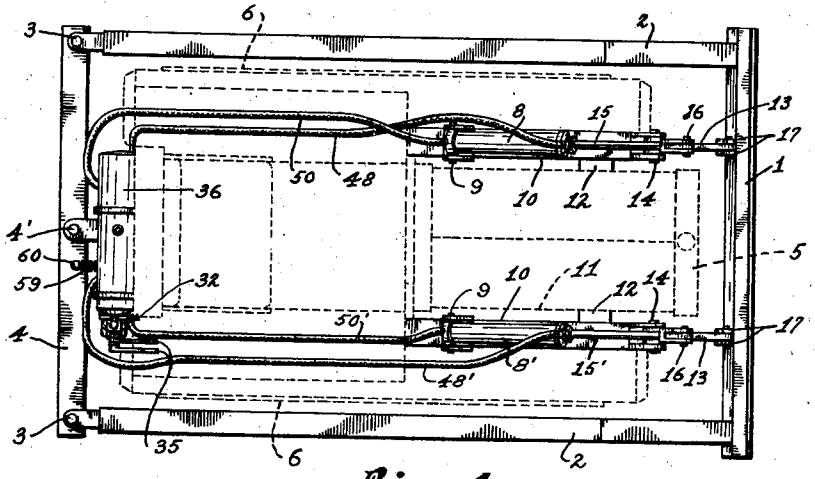


Fig. 1.

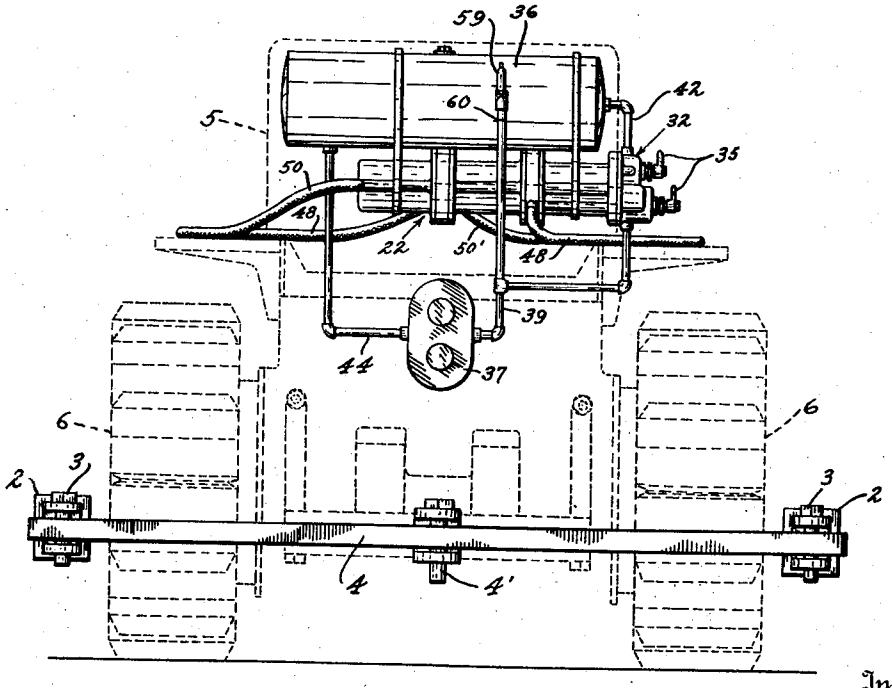


Fig. 2.

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HYDRAULIC CONTROL FOR TRAIL BUILDER

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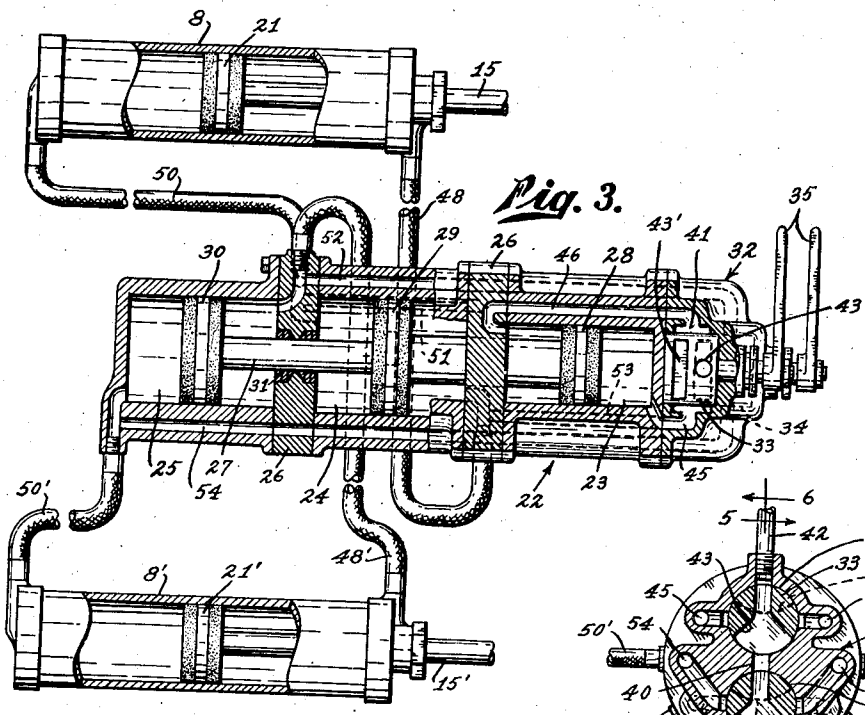


Fig. 3.

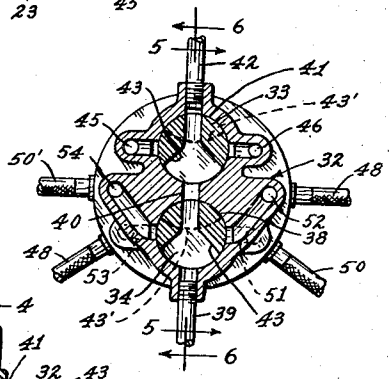


Fig. 4.

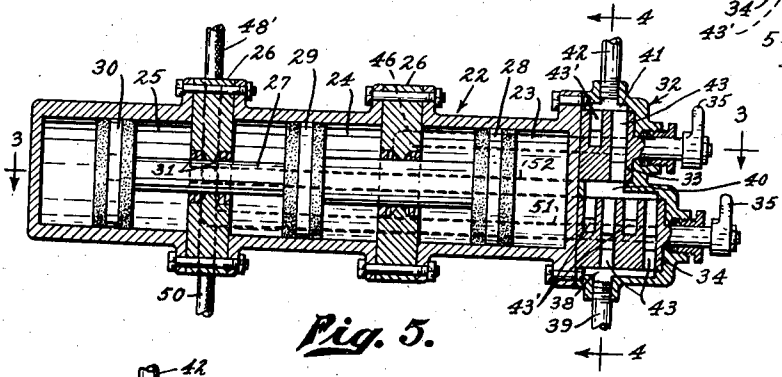


Fig. 5.

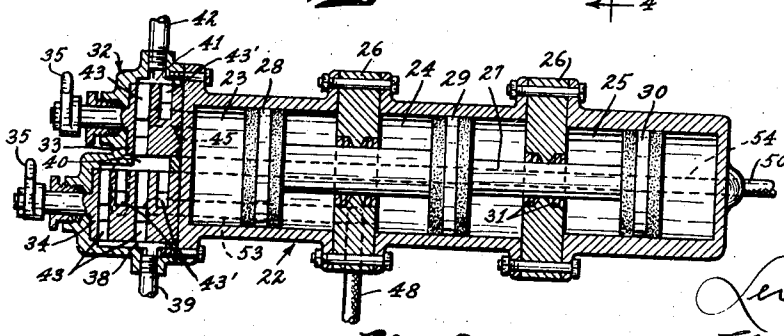


Fig. 6.

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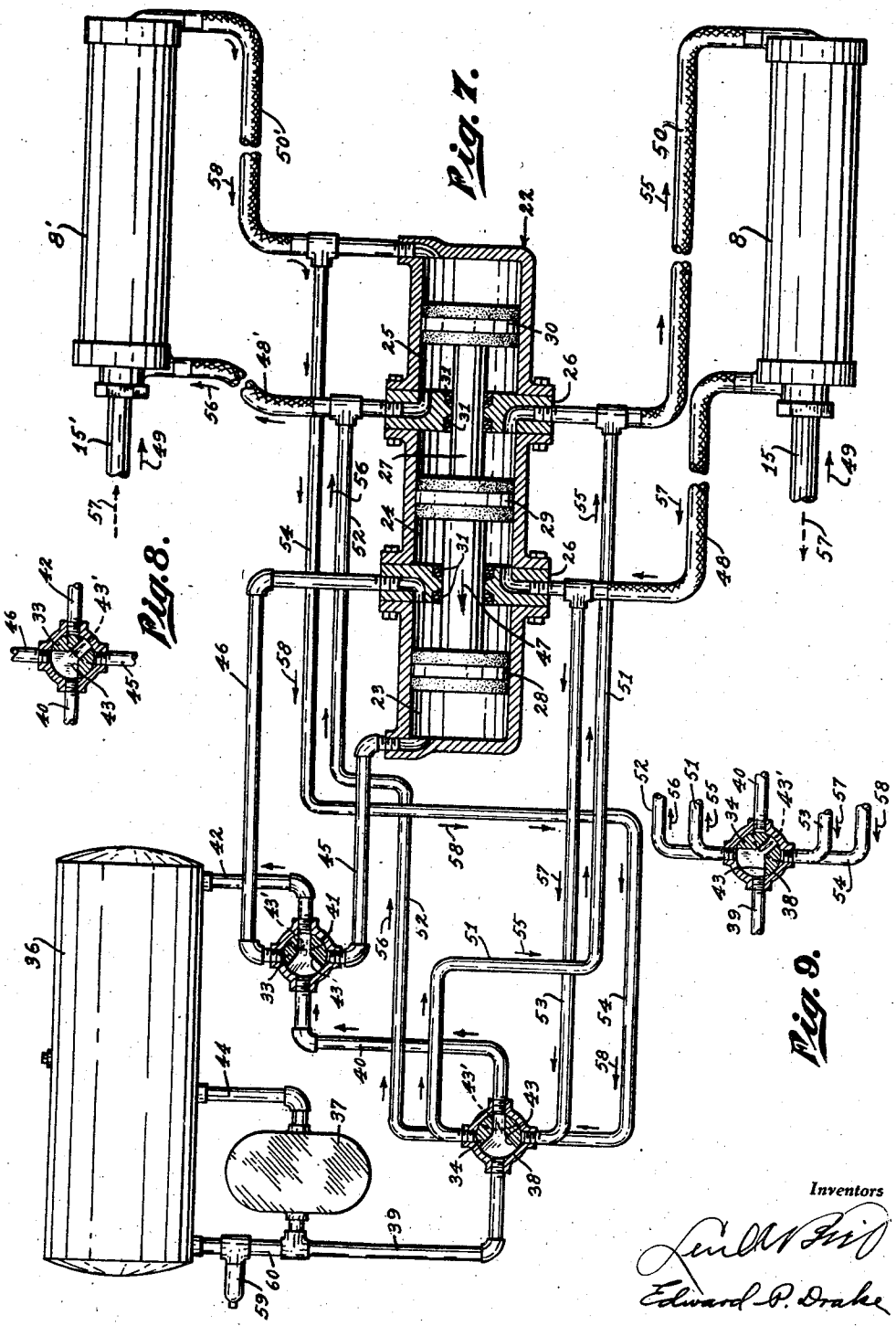


Fig. 7.

Fig. 8.

Fig. 9.

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HYDRAULIC CONTROL FOR TRAIL BUILDER

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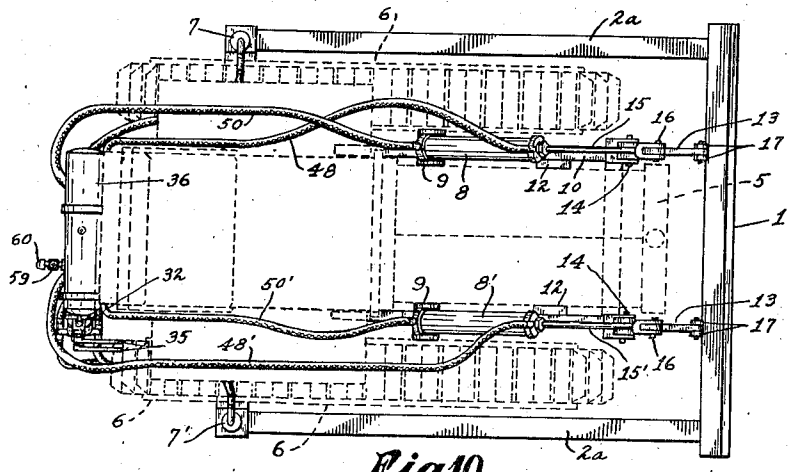


Fig.10.

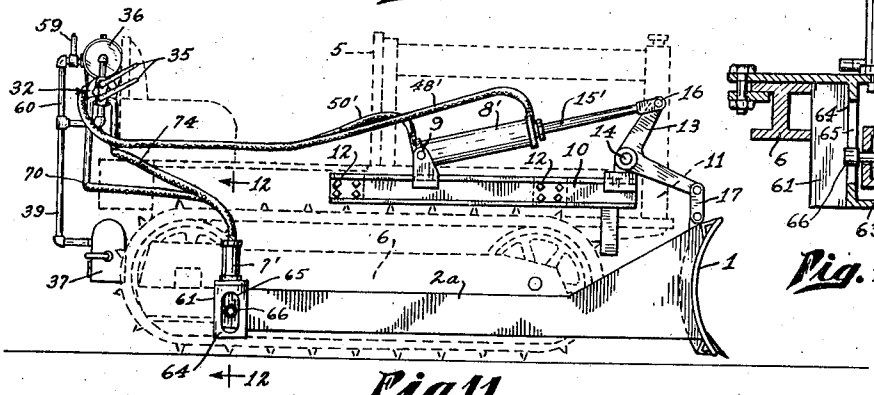


Fig.11.

Fig.12.

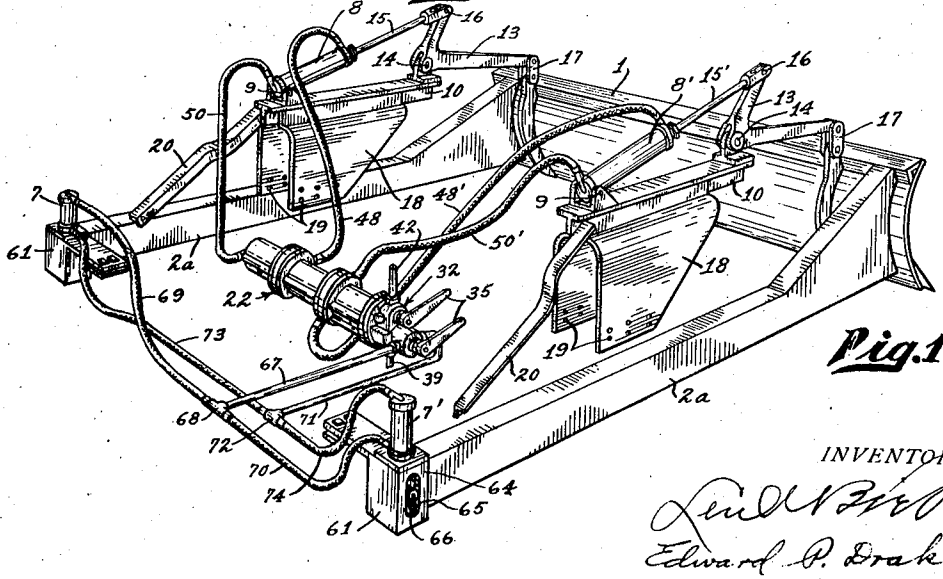


Fig.13.

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HYDRAULIC CONTROL FOR TRAIL BUILDER

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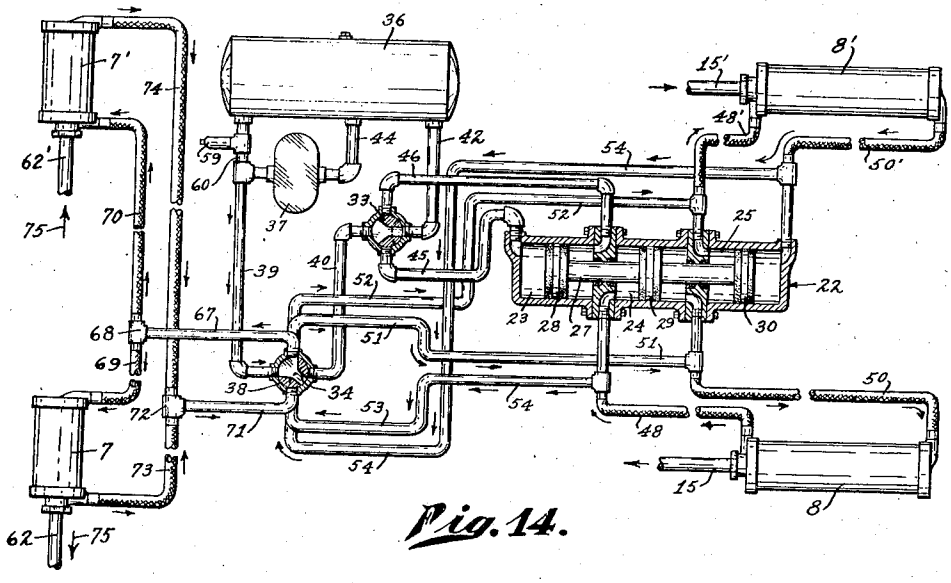


Fig. 14.

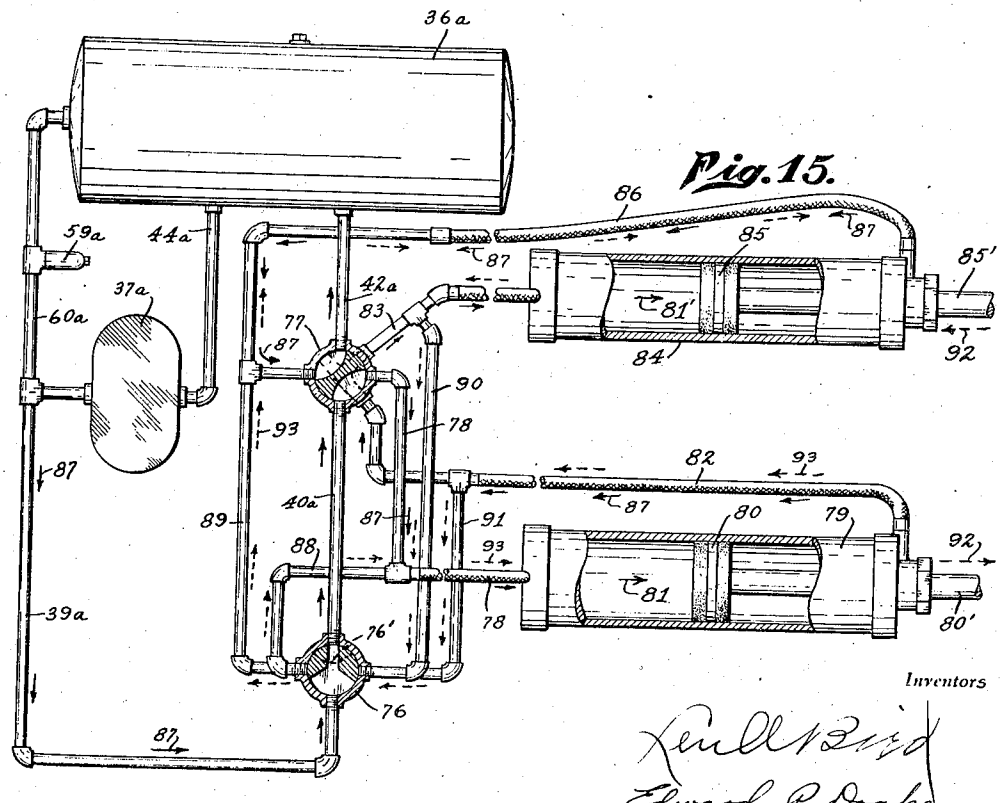


Fig. 15.

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Patented Jan. 2, 1940 2,185,179

UNITED STATES PATENT OFFICE

2,185,179

HYDRAULIC CONTROL FOR TRAIL BUILDER

Len O. Bird, Glendale, and Edward P. Drake, Los Angeles, Calif.; said Drake assignor to said Bird

Application June 1, 1935, Serial No. 24,562

10 Claims. (Cl. 37—144)

This invention relates to new and useful improvements in trail builders, bulldozers, back fillers, and the like and more particularly to a hydraulic control system and to the manner of mounting said hydraulic control system and the implement on a tractor, and inasmuch as there is common subject matter it is a continuation of improvements in the type of controls and mountings illustrated, described and claimed in applications executed by Len O. Bird, the above mentioned joint inventor in the present application, and filed as follows:

Filed Oct. 30, 1931, Serial No. 572,044, Pat. No. 1,991,781; filed Dec. 27, 1932, Serial No. 648,898, Pat. No. 1,964,617; filed Jan. 3, 1933, Serial No. 649,921, (since abandoned); filed Feb. 1, 1933, Serial No. 654,577 (since abandoned); filed Aug. 8, 1933, Serial No. 684,215, Pat. No. 1,976,597; filed Nov. 6, 1933, Serial No. 696,786, Pat. No. 1,977,817.

Of the manifold objects of this invention the principal one is the provision of hydraulic controls for a trail builder by means of which the blade may be, raised, and lowered for controlling the inoperative and operative positions, tilted to control the angle of the cutting edge with respect to the ground surface, and angled from the transverse position to cast the removed material to either side, while the tractor is in motion.

A further object is the provision of a trail builder in which the means for raising, lowering and tilting the blade as well as the means for angling same, consist of two hydraulic power units connected directly or through suitable levers to the implement or blade and associated with a valve device which controls each power unit through an independent fluid column insuring positive action of each power unit, eliminating the counter shaft which has to be used when the power units are connected in series for operation through a common column of fluid as has heretofore been the case, also a countershaft control limits the versitality of the system to controlling only the operative and inoperative positions and requiring an independent means for tilting same.

Another object is the provision of an implement of the character described in which the hydraulic control system is equiped with equalizing or compensating means consisting of cylinder and piston assemblies operatively interposed between the tracklayer frames and the engine bed, and connected to the power unit conduits, to utilize the relative movement between the engine bed and the tracklayer frames for displacing fluid between the compensating cylinders and the power units to maintain the blade in the set position regardless of any uneven surface traversed by the tractor.

A further object is the provision of an implement of the character described in which the pusher arms carrying the blade member are provided near the rear ends with auxiliary hydraulic jacks associated with the control system to act simultaneously with the power units for tilting the blade by raising one pusher arm and lowering the other on an even keel to prevent distortion of the implement.

Another object is the provision of a master cylinder and valve arrangement which may be installed in any implement using two or more power units for controlling the degree and class of operation to render said implement capable of performing the above outlined functions.

A further object is to provide suitable mountings and connections for the numerous types of implements to advantageously utilize the meritorious characteristics of the control system in each individual case with maximum efficiency and economy.

With these and other objects in view the invention consists in the combination, correlation, and construction, of parts, members and features which will be described in the specification and will be finally pointed out in the claims.

Referring to the drawings:

Figure 1 is a plan view of a device embodying our invention.

Figure 2 is a rear end elevation of Figure 1, illustrating the mounting of the device on a tractor.

Figure 3 is a semidiagrammatic view of the hydraulic control system illustrating the master cylinder in section as indicated by line 3—3 in Figure 5.

Figure 4 is a section approximately on line 4—4 of Figure 5 illustrating the control valve in detail.

Figure 5 is a section on line 5—5 of Figure 4.

Figure 6 is a section on line 6—6 of Figure 4.

Figure 7 is a diagrammatic view of the hydraulic system in which the parts and passages within the valve and master cylinder are represented by means of tubing connections to facilitate the illustration of the flow of fluid.

Figure 8 is a detail of the raising and lowering valve in one of the operative positions.

Figure 9 is a detail of the tilting valve in one of the operating positions.

Figure 10 is a plan view of an implement similar to that shown in Figure 1 illustrating means for connectng the pusher arm to the tracklayer

frames of the tractor and additional hydraulic jacks for tilting the pusher arms.

Figure 11 is a side elevation of Figure 10.

Figure 12 is a section on line 12—12 of Figure 11.

Figure 13 is a perspective view of a modified form of mounting illustrating the hydraulic control system diagrammatically.

Figure 14 is a diagrammatic flow chart of the hydraulic control system shown in Figures 11, 12, and 13.

Figure 15 is a diagrammatic flow chart of a hydraulic control system in which the master cylinder is eliminated.

The objects outlined above are attained by the preferred and modified forms of embodiment of the invention shown in the drawings, which in a generic sense consists of an implement comprising a pair of pusher arms connected at the rear ends either to the draw bar or the tracklayer frames of a tractor and carrying at the forward ends a blade element which may be of the rigid transverse type, the tiltable type, the angling type or adapted for performing any two or all three of these functions singly or in combination, manually or hydraulically, a hydraulic control system comprising a pair of hydraulic power units mounted on suitable brackets secured either to the engine bed or the tracklayer frames of the tractor, means for supplying fluid under pressure in individual columns of identical volumes to the hydraulic power units to facilitate positive action of said power units, equalizing or compensating means for dispensing fluid to the power units in proportion to the tilting or swaying of the tractor for maintaining the blade element in the set position, auxiliary hydraulic pusher arm jacks associated with the control system to operate simultaneously with the power units for tilting the implement on an even keel, and valve means for controlling the hydraulic system from the operator's station.

Referring to Figures 1 to 13 inclusive:

In a more specific sense, the preferred form of the control means for an implement exemplified in the accompanying drawings in a practical form of embodiment, is shown as comprising the usual blade member 1 and a pair of rearwardly extending pusher arms 2 connected as at 3 to the draw bar 4 of tractor 5.

In Figures 10, 11, 12, and 13 the pusher arms 2a are shown connected to tracklayer frames 6 of the tractor 5 through means permitting vertical movement upon actuation of the hydraulic jacks 7, and 7' which will be described in more detail hereinafter.

The hydraulic control system consists of a pair of hydraulic cylinders 8 and 8' pivotally mounted, as at 9, on brackets 10 secured to the sides of engine bed 11 of tractor 5, as at 12, a pair of bell cranks 13 pivotally mounted on brackets 10, as shown at 14, are connected to piston rods 15 and 15', as at 16, and to the blade 1 through links 17.

In some cases, especially in heavy duty implements, it is advisable to mount the brackets 10 carrying the cylinders 8 and 8' and the bell cranks 13 on the tracklayer frames of the tractor since the tracklayer frames are adapted to carry a greater load than the engine bed. Figure 11 illustrates how the brackets 10 may be secured on U-shaped supports 18 which straddle the tracklayers and fasten to the sides of the tracklayer frames 6 by means of screws, bolts, or rivets, for which holes 19 are provided. The supports 18 may be reinforced by means of braces 20.

The operation of the pistons 21 and 21' within cylinders 8 and 8' is controlled by a master cylinder 22 which is divided into three chambers, the power chamber 23 and the chambers 24 and 25, for controlling cylinders 8 and 8', respectively, by means of the closures 26. A piston rod 27 having the pistons 28, 29, and 30 arranged thereon to function within chambers 23, 24, and 25 respectively. Closures 26 are provided with pressure packing 31 at the points where piston rod 27 passes through.

At the power chamber end of the master cylinder 22 a valve 32 is located; said valve comprises a pair of plugs 33 and 34 individually operated by means of handles or levers 35. The plug 33 is used for raising and lowering the implement and the plug 34 for tilting same.

Included in the system is a reservoir tank 36 and pump 37 of any conventional type associated in the usual manner with the power takeoff on the tractor. The pressure side of pump 37 communicates with the valve chamber 38 through conduit 39, then through pipe or conduit 40 with valve chamber 41 and then through conduit 42 with tank 36.

The valve plugs 33 and 34 are provided with fan shaped ports 43 to direct the fluid under pressure in three selective directions, and the return ports 43'. When the plugs 33 and 34 are in the neutral or inoperative position the ports 43 are aligned to effect by passing or circulation of fluid from the tank 36 through conduit 44, pump 37, conduit 39, port 43 of plug 34, pipe 40, port 43 of plug 33 and conduit 42 back into tank 36.

The valve chamber 41 communicates with the opposite ends of the power chamber 23 through the diametrically opposed ports 45 and 46. By manipulating the plug 33 fluid under pressure is admitted to the power chamber 23 for actuation of piston rod 27 and pistons 28, 29, and 30 to cause displacement of fluid between chambers 24 and 25 and the cylinders 8 and 8' respectively, for actuating the pistons and piston rods in said cylinders simultaneously to raise and lower the implement.

In Figures 7, 8, and 9, the hydraulic system is illustrated diagrammatically where the various ports in the valve housing and master cylinder are represented by the pipe conduits to facilitate a comprehensive showing of the fluid flow. Each pipe connection between the valves and cylinder bears the same reference number as the port it represents in the practical form shown in Figures 3, 4, 5, and 6. When describing the flow of fluid and the operation of the system reference will be had to Figures 7, 8, and 9.

When it is desired to raise the implement the valve plug 33 is manipulated as shown in Figure 8 to direct the fluid from pump 37, through conduit 39, port 43 in plug 34, port 40, port 43 in plug 33 and port or conduit 46 to the power chamber 23 of master cylinder 22, causing the piston rod to move in direction of arrow 47 forcing the fluid ahead of piston 28 through port or conduit 45, return port 43' in plug 33 and conduit 42 into tank 36.

The movement of piston rod 27 causes fluid in chambers 24 and 25 to be directed to cylinder 8 and 8' through conduits 48 and 48' respectively causing piston rods 15 and 15' to move in direction of arrows 49 thereby raising the implement. By manipulating plug 33 to direct the fluid through port or conduit 45 to the opposite end of

power chamber 23 the direction of movement of piston rod 27 is reversed to direct fluid to cylinder 8 and 8' through conduit 50 and 50' and thereby lowering the implement.

It will be noted that the chamber 24 in the master cylinder 22 is slightly larger in diameter than the chamber 25 and that the portion of the piston rod 27 between pistons 28 and 29 is larger in diameter than the portion between the pistons 29 and 30. The reason for this variation in diameters is to effect an equal volumetric displacement of fluids between chambers 24 and 25 and the cylinders 8 and 8', respectively, so that the movement of the piston rods 15 and 15' is simultaneously equal. Also the reason for providing the individual control chambers 24 and 25 and pistons 29 and 30 for cylinders 8 and 8', respectively, is to control the cylinders 8 and 8' through individual fluid columns to insure equal distribution of pressures to both cylinders so that the implement may be raised and lowered without disturbing the set position of the blade regardless of any unbalanced resistances or loads.

Heretofore in implements using a pair of cylinders for controlling the degree of operation a common source of pressure was provided for actuating both cylinders. This proved to be ineffectual because when one end of the blade encountered a hard spot, rock, or other obstruction, upon being lowered into the operating position, greater resistance was offered to the piston controlling that side of the implement thereby retarding the action of said piston and accelerating the action of the other piston consequently tilting the blade. Later a countershaft with bell cranks connecting the cylinders to the implement was provided which made it possible to raise and lower the blade and maintain its set position regardless of any unbalanced load or resistance, but impossible to tilt the blade by means of the same cylinders consequently it was necessary to provide an independent tilting device which naturally increased considerably the cost of manufacture.

In the present hydraulic control system a very simple arrangement of ports is provided for directing fluid from the valve chamber 38 to the cylinders 8 and 8' to actuate the pistons 21 and 21' and piston rods 15 and 15' in opposite directions for tilting the blade 1.

One side of the valve chamber 38 communicates through the port or conduit 51 with conduit 50 of cylinder 8 and through the port or conduit 52 with conduit 48' of cylinder 8'. The opposite side of valve chamber 38 communicates through the port or conduit 53 with the conduit 48 of cylinder 8 and through the port or conduit 54 with the conduit 50' of cylinder 8'.

When it is desired to tilt the blade 1 so that the right side of same is raised and the left side lowered the plug 34 is manipulated as shown in Figure 9 to direct the fluid through port or conduits 51 and conduit 50 to the cylinder 8 as indicated by arrows 55 and to direct the fluid through port or conduit 52 and conduit 48' to the cylinder 8' as indicated by arrows 56, causing the piston rods 15 and 15' to move in the opposite directions as indicated by the dotted arrows 57. The fluid expelled by this movement of pistons 21 and 21' within cylinders 8 ad 8' is returned to tank 36 through conduits 48 and 50', ports or conduits 53 and 54, return port 43' in plug 34, port 40, port 43 in plug 33 and conduit 42, as indicated by the arrows 57 and 58 respectively.

By manipulating the plug 34 to direct the fluid to ports or conduits 53 and 54 the blade 1 may be tilted in the opposite direction.

By means of this system the blade may be tilted in any of its operative or inoperative positions and it may be raised and lowered without disturbing the set position regardless of any unbalanced resistance or load.

To relieve excess pressure beyond a predetermined point within the system a pop-off valve 59 is interposed in conduit 60 connecting the pressure side of pump 37 to tank 36.

When the control system is used on an implement connected to the draw bar 4 of the tractor, as depicted in Figures 1 and 2 the implement and blade may be tilted without twisting strains on pusher arms 2 by virtue of the centrally located draw bar hitch 4' which permits the draw bar 4 to tilt with the implement. However, when the implement is connected to the tracklayer frames 6 as shown in Figures 10, 11, and 13 the implement and blade cannot be tilted without exerting twisting strains on the pusher arms 2a and blade 1, therefore, auxiliary hydraulic jacks 7 and 7' are provided at the ends of pusher arms 2a to automatically raise and lower same as required in tilting the implement.

The hydraulic jacks 7 and 7' are mounted on brackets 61 which are secured in any suitable manner to the tracklayer frames 6. The piston rods 62 and 62' of the jacks 7 and 7' are pivotally connected, as at 63, to the ends of pusher arms 2a. The side walls 64 of brackets 61 have the vertically elongated slots 65 which operatively engage the rollers 66 at the ends of pusher arms 2a. The slot and roller connections 65 and 66, respectively, permit vertical movement of the pusher arms 2a upon actuation of jacks 7 and 7' in addition to effecting a sturdy thrust connection for longitudinal pushing of the implement.

The hydraulic jacks are connected to tilting valve chamber 38 on the side where ports or conduits 51 and 52 communicates with said chamber, through conduit 67, T 68 and conduit 69 and 70 leading to the top and bottom of the jacks 7 and 7', respectively. On the opposite side of chamber 38 where ports or conduits 53 and 54 communicate with said chamber is another conduit 71 which leads through T 72, conduits 73 and 74 to the bottom and top of jacks 7 and 7' respectively.

In Figure 14 the control system in combination with the hydraulic jacks is diagrammatically illustrated and shows the plug valve 34 in position for directing the fluid to ports or conduits 51 and 52 to tilt the implement as has been described above. The port 43 of plug 34 also directs the fluid through conduit 67 and conduits 69 and 70 to the top and bottom of jacks 7 and 7', respectively, to actuate the piston rods 62 and 62' in opposite directions, as indicated by arrows 75.

It will be noted that the cylinder 8 and hydraulic jack 7 control the left side of the implement and cylinder 8' and hydraulic jack 7' the right side and inasmuch as each cylinder and its corresponding hydraulic jack operate in unison one pusher arm 2a is raised and the other lowered parallel to the horizontal line for tilting the blade thus eliminating bending and twisting strains.

By positioning plug 34 to direct the fluid to ports or conduits 53 and 54 and conduit 71 the tilting of the implement will be reversed.

A modified form of the hydraulic control system shown diagrammatically in Figure 15 illustrates how the raising and lowering valve and the

tilting valve may be connected with the control cylinders to eliminate the master cylinder 22 and still render the system capable of performing the same functions.

The suction side of pump 37a is connected to tank 36a through conduit 44a and the pressure side of pump 37a is connected to the tilting valve 76, then through conduit 40a to the raising and lowering valve 77 and then through conduit 42a to tank 36a to circulate the fluid through the valves and the tank when said valves are in the neutral position. The pressure relief valve 59a is interposed in conduit 60a which connects the pressure side of pump 37a with tank 36a to relieve excess pressure, beyond a predetermined point, in the system, as shown and described in the preferred form.

When the raising and lowering valve 77 is in the position shown in Figure 15 the fluid is directed from pump 37a through conduit 39a, tilting valve 76, conduit 40a, raising and lowering valve 77 and conduit 78 to cylinder 79 causing piston 80 to move in direction of arrow 81. The fluid expelled from cylinder 79 by means of piston 80 is directed through conduit 82, valve 77 and conduit 83 to cylinder 84 causing both cylinders to operate simultaneously in direction of arrows 81 and 81' for lowering the implement. The fluid expelled from cylinder 84 by means of piston 85 is directed through conduit 86 valve 77 and conduit 42a to tank 36a. The direction of fluid for lowering the implement is indicated by means of arrows 87.

By manipulating the valve 90 degrees the direction of fluid within the system will be reversed causing pistons 80 and 85 within cylinders 79 and 84 to move in the opposite direction for raising the implement.

It will be noted that the cylinder 79 is slightly larger in diameter than the cylinder 84; this is to equalize the area of the piston rod end of cylinder 79, and the opposite end of cylinder 84 so that there is equal volumetric displacement of fluid between said ends of the cylinders for simultaneously equal movement of pistons 80 and 85.

One side of the tilting valve 76 communicates with conduit 78 through conduit 88 and with conduit 86 through conduit 89, the opposite side of the valve communicates with conduit 83 through conduit 90 and with conduit 82 through conduit 91.

When it is desired to tilt the blade by raising the left side and lowering the right side of the implement the valve 76 must be manipulated to direct the fluid from conduit 39a through conduits 88 and 78 to cylinder 79 and through conduits 89 and 86 to cylinder 84 causing the pistons 80 and 85 and the piston rods 80' and 85' to move simultaneously in opposite directions as indicated by the dotted arrows 92. The fluid expelled by pistons 80 and 85 is directed from cylinder 79 and 84 through conduits 82, and 91, and conduits 83 and 90, respectively, to valve 76, then through port 76' in the valve plug, conduit 40a, valve 77 and conduit 42a to tank 36a. The direction of fluid for tilting the blade is indicated by means of the dotted arrows 93.

By manipulating the valve 90 degrees the direction of fluid within the system will be reversed causing the blade to tilt in the opposite direction.

Having thus described our invention we claim:

1. A trail builder, in combination with a tractor, comprising a pair of forwardly extending pusher arms connected to the tracklayer frames of said tractor, a scraping implement on the forward ends of said pusher arms, hydraulic jacks mounted on said tracklayer frames, bell crank means for connecting said hydraulic jacks to said scraping implement, plunger means for actuating each hydraulic jack through an individual column of fluid, hydraulic means for actuating said plunger means.

2. In a trail builder comprising a tractor, a pair of forwardly extending pusher arms, vertically slidable means for connecting said pusher arms to the tracklayer frames of said tractor, a pair of primary hydraulic jacks associated with said vertically slidable connections for vertical adjustment of the rear ends of said pusher arms, a pair of secondary hydraulic jacks mounted on the tracklayer frames of said tractor, means for associating said secondary hydraulic jacks with said pusher arms for vertical adjustment of the forward ends of said pusher arms, a pair of valves for controlling said primary and secondary jacks, each valve controlling one primary jack and one secondary jack in unison.

3. A trail builder, in connection with a tractor, comprising a pair of forward-extending pusher arms connected to said tractor, a scraping element at the forward ends of said pusher arms, hydraulic jacks mounted on said tractor and operatively engaged with said pusher arms and scraping element, plunger means for actuating each hydraulic jack through individual columns of fluid, hydraulic means for actuating said plunger means.

4. A trail builder, in combination with a tractor, comprising a pair of pusher arms, a pair of hydraulic jacks mounted on said tractor, arranged to adjust the forward ends of said pusher arms vertically, plunger means for actuating each hydraulic jack through individual columns of fluid, hydraulic means for actuating said plunger means, a pair of hydraulic jacks mounted on said tractor, arranged to adjust the rear ends of said pusher arms vertically, valve means for controlling the vertical adjustment of the rear ends of said pusher arms.

5. A trail builder, in combination with a tractor, comprising a pair of pusher arms connected to said tractor and a blade on said pusher arms, a multiplicity of hydraulic jacks mounted on said tractor and operatively associated with said pusher arms and blade, plunger means for actuating each hydraulic jack through individual columns of fluid, hydraulic means for actuating said plunger means, valve means associated with said plunger, a plunger actuating means to actuate said jacks in one direction simultaneously to raise or lower the blade and valve means to actuate said jacks in opposite directions simultaneously to tilt said blade.

6. In combination with a tractor, a trail builder comprising a pair of pusher arms connected to said tractor and a blade on said pusher arms, hydraulic jacks mounted on said tractor and operatively associated with said pusher arms and blade, plunger means for directing an individual column of fluid to each of said jacks, hydraulic pressure means for actuating said plunger means, valve means for directing individual columns of fluid to said jacks for simultaneous operation in either direction to raise and lower said blade and valve means for directing the fluid to said jacks for simultaneous operation in opposite directions for tilting said blade.

7. In a trail builder as described in claim 6, in which the plunger means comprises a cylin-

der containing a pressure chamber for each hydraulic jack and a power chamber, a piston in each chamber arranged in tandem on a common piston rod, a pump to suply fluid under pressure to said power chamber, valve means for controlling the fluid under pressure from said pump to said power chamber, fluid conduits from said pressure chambers to said hydraulic jacks.

8. In combination with a tractor, a trail builder comprising a pair of pusher arms connected to said tractor and a blade on said pusher arms, a pair of hydraulic jacks mounted at the side of said tractor and operatively associated with said pusher arms and blade, plunger means for directing an individual column of fluid to each of said jacks, hydraulic means for actuating said plunger means, valve means arranged for controlling said jacks to raise, lower and tilt said blade.

9. In a trail builder as described in claim 8 in which the plunger means comprises a cylinder containing a pressure chamber for each hydraulic jack and a power chamber, a piston in each chamber arranged in tandem on a common piston rod, a pump to supply fluid under pressure to said power chamber, fluid conduits from said pressure chambers to said hydraulic jacks, valve means for directing the fluid under pressure from said pump to either end of said power chamber and thereby actuating said pistons in said pressure chambers for directing fluid under pressure to said hydraulic jacks.

10. In combination with a tractor, a trail builder comprising a pair of pusher arms connected to said tractor through a vertically movable means, a blade on said pusher arms, means mounted on said tractor and connected to said pusher, arms and blade to control the degree of operation thereof, a pair of hydraulic jacks mounted on said tractor and connected to said vertically movable connecting means, hydraulically controlled means associated with said jacks to actuate said jacks in either direction simultaneously for raising and lowering said pusher arms and means for actuating said jacks simultaneously in opposite directions for tilting said pusher arms and blade.

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