

March 1, 1938.

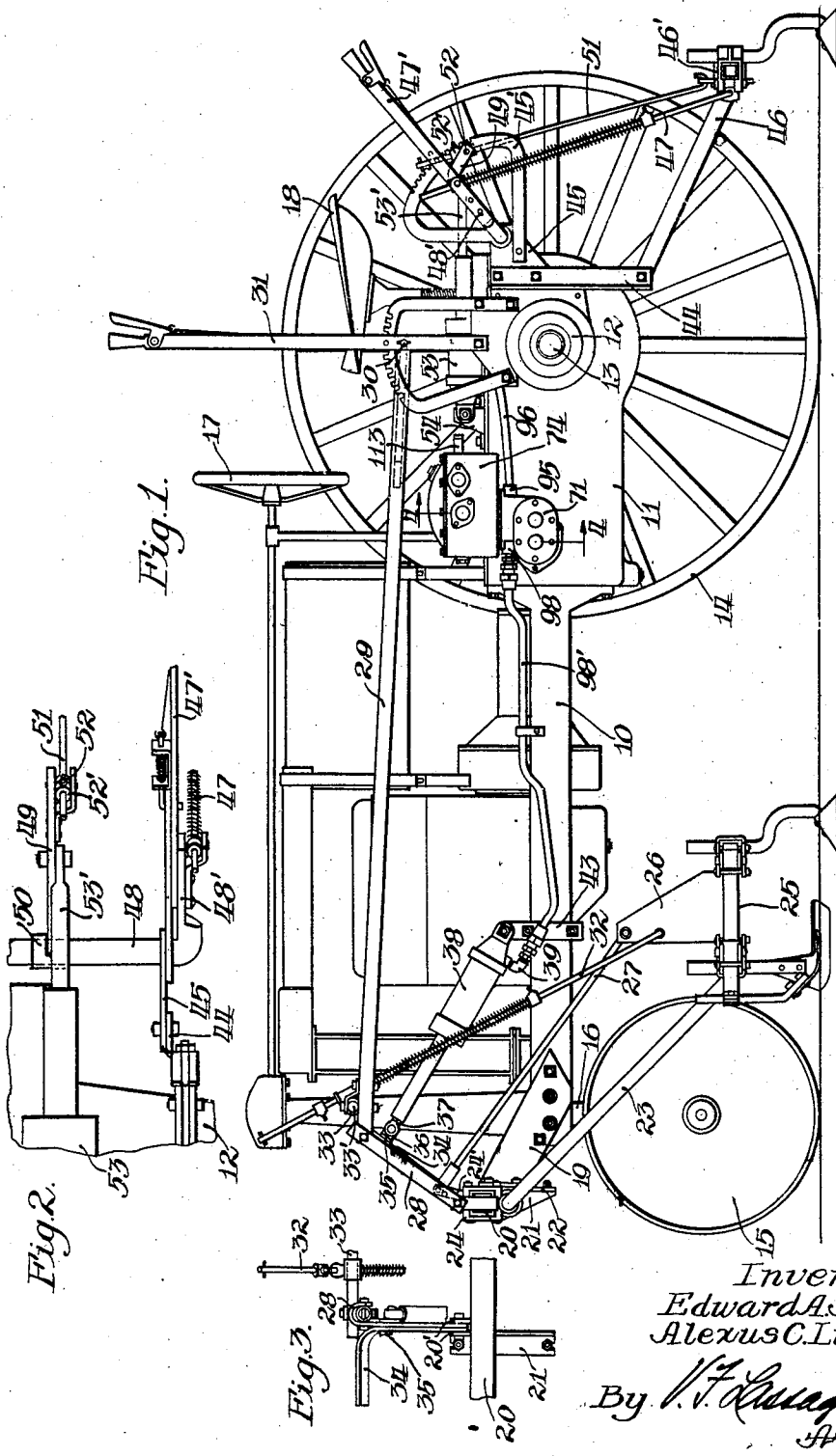
E. A. JOHNSTON ET AL

2,109,668

HYDRAULIC LIFT MECHANISM FOR TRACTORS

Filed April 6, 1937

4 Sheets-Sheet 1



March 1, 1938.

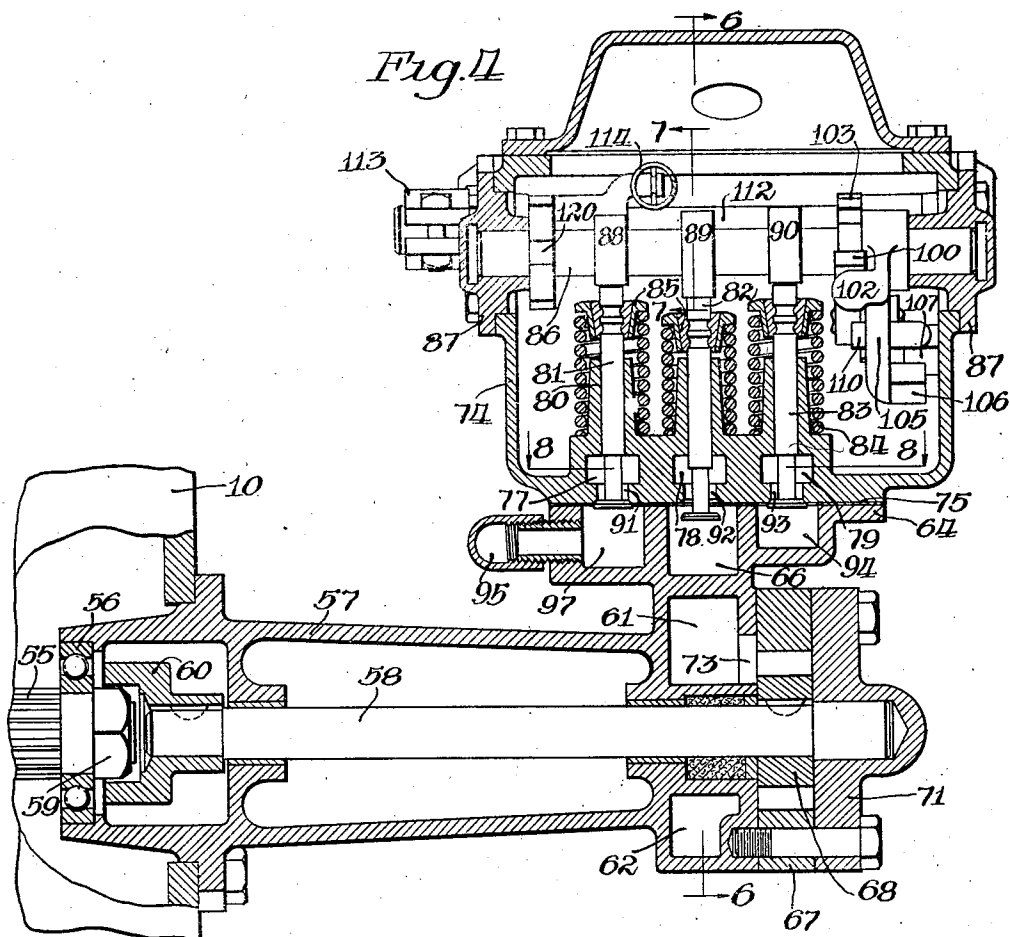
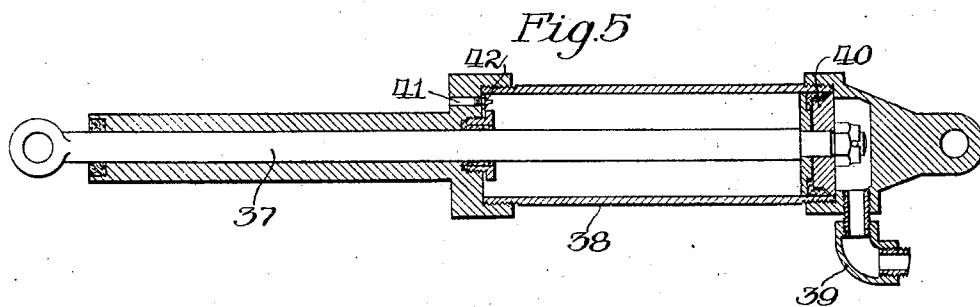
E. A. JOHNSTON ET AL

2,109,668

HYDRAULIC LIFT MECHANISM FOR TRACTORS

Filed April 6, 1937

4 Sheets-Sheet 2



Inventor
Edward A. Johnston
Alexus C. Lindgren.
By *V. F. Lague*
Att'y.

March 1, 1938.

E. A. JOHNSTON ET AL

2,109,668

HYDRAULIC LIFT MECHANISM FOR TRACTORS

Filed April 6, 1937

4 Sheets-Sheet 3

Fig. 6.

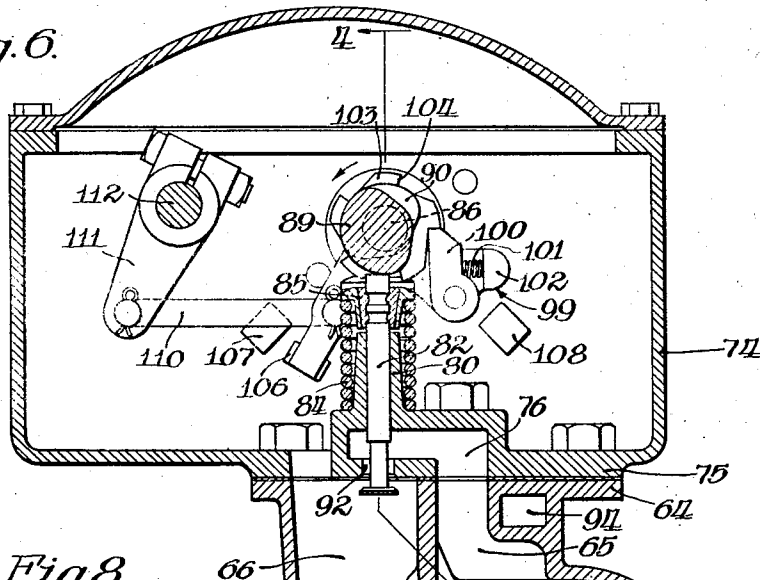


Fig. 8.

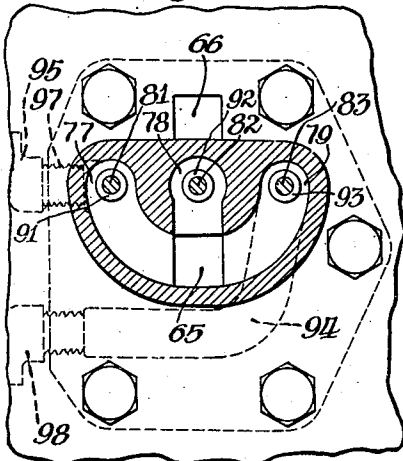


Fig. 9.

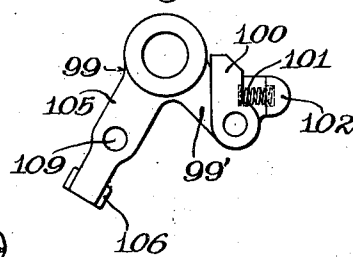
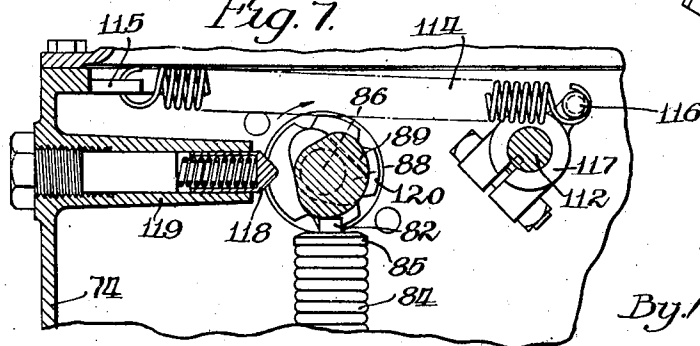


Fig. 7.



Inventor
Edward A. Johnston
Alexus C. Lindgren

By *W. F. Lavigne*
Att'y.

March 1, 1938.

E. A. JOHNSTON ET AL

2,109,668

HYDRAULIC LIFT MECHANISM FOR TRACTORS

Filed April 6, 1937

4 Sheets-Sheet 4

Fig. 15

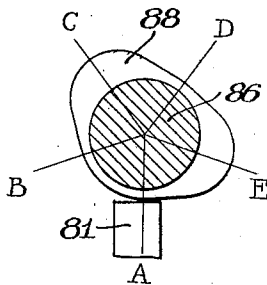


Fig. 16

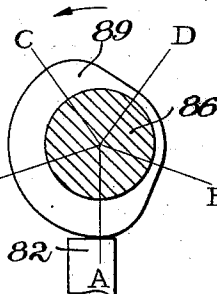
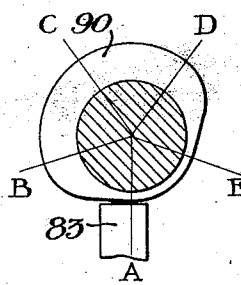
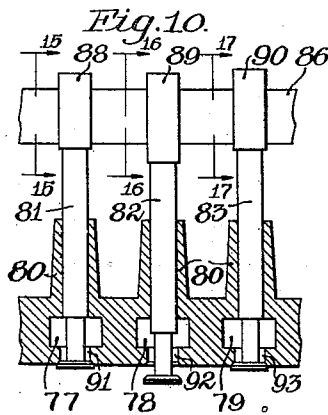
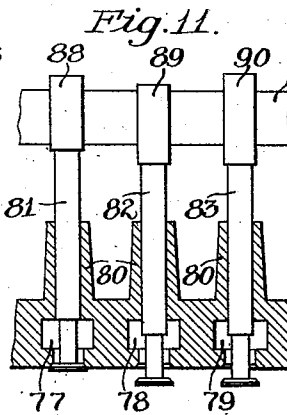
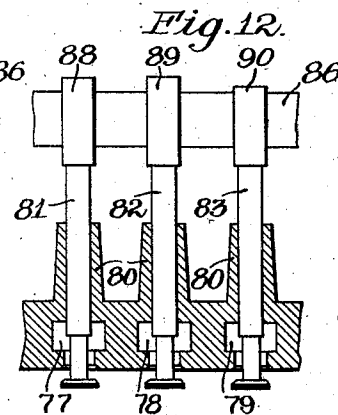
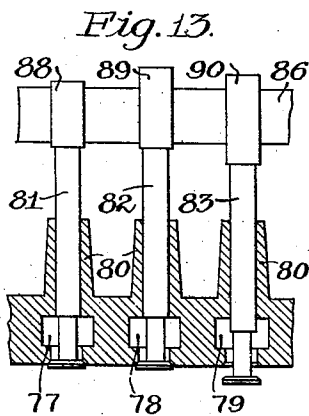
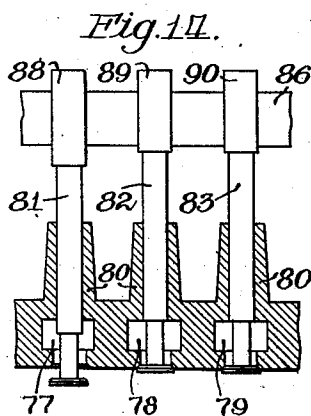


Fig. 17



Inventor
Edward A. Johnston
Alexus C. Lindgren

By *V. F. L. L. L.*
Att'y.

UNITED STATES PATENT OFFICE

2,109,668

HYDRAULIC LIFT MECHANISM FOR TRACTORS

Edward A. Johnston and Alexis C. Lindgren, Chicago, Ill., assignors to International Harvester Company, a corporation of New Jersey

Application April 6, 1937, Serial No. 135,304

7 Claims. (Cl. 97—50)

This invention relates to a power lift device for tractors. More specifically, it relates to a hydraulically operated device for supplying liquid under pressure to independent lifting units adapted to adjust implements connected to an agricultural tractor.

The principal object of the invention is the construction of a hydraulic power lift system incorporating a single control unit operable to positively and independently actuate a plurality of independent lifting means located at different places on a tractor.

Another object is to provide an improved consecutive lift for the front and rear implements of an agricultural tractor.

Another object is the provision of an actuating means for a hydraulic control unit which has a cycle of operation effective to operate a plurality of hydraulic units in the desired order.

The above objects and others, which will be apparent from the detailed description to follow, are accomplished by utilizing individual hydraulic cylinder units for the front and rear implements mounted on an agricultural tractor. The pump for the hydraulic unit is driven from a power shaft of the tractor. The control unit for delivering liquid under pressure to the lifting cylinders is manually controlled by a valve mechanism. Said mechanism is operated on a cycle made possible by the use of a ratchet device. By means of a ratchet device on a cam shaft, different valves controlling different fluid passages may be consecutively operated in a predetermined sequence. By this means, pressure may be applied consecutively to the lifting cylinders and released in the same order. Provision is also made for neutral positions with the implements either lifted or in operating position.

In the drawings:

Figure 1 is a side elevation of an agricultural tractor of the general purpose type with one of the rear wheels removed to better show the implements mounted thereon;

Figure 2 is a plan view of a portion of the implement connection at the rear of the tractor;

Figure 3 is a front elevation of a portion of the implement connection at the front of the tractor;

Figure 4 is a vertical section on the line 4—4 of Figures 1 and 6;

Figure 5 is a cross section through the lifting cylinder used at the front of the tractor;

Figure 6 is a section taken on the line 6—6 of Figure 4;

Figure 7 is a section taken on the line 7—7 of Figure 4;

Figure 8 is a section taken on the line 8—8 of Figure 4;

Figure 9 is an end view of the ratchet member utilized in the manual control;

Figure 10 is a diagrammatic view of the control shaft, cams carried thereby, and the valves operated by the cams, showing one position in the cycle of operation;

Figures 11, 12, 13 and 14 show the same elements as Figure 10, illustrating the successive steps in the cycle of operation of the control device for the power lift constituting the invention;

Figure 15 is a sectional view on the line 15—15 of Figure 10 showing one of the operating cams. The letters A, B, C, D and E on the figure represent the five positions of the cam with relation to the stem of the valve which it controls;

Figure 16 is a sectional view on the line 16—16 of Figure 10 showing another of the control cams; and,

Figure 17 is a sectional view on the line 17—17 of Figure 10 showing the third control cam.

In the drawings, a tractor has been shown somewhat diagrammatically to illustrate implements and the lift connections with the power lift mechanism of the invention. Certain parts of the tractor will be designated by numerals to form a basis for adequate description of implements and the power lift mechanism.

The tractor is illustrated as a narrow frame 10 connected to a rearwardly located casing 11, which forms the transmission casing and the final drive housing. Laterally extending housings 12 support the tractor axles 13 on which drive wheels 14 are mounted.

At the forward end of the tractor, steerable front wheels 15 are mounted on a steering post 16 controlled by suitable mechanism from a steering wheel 17 located within reach of the operator seated on a seat 18 at the rear of the tractor.

At the forward end of the frame 10, forwardly and upwardly extending plates 19 are rigidly secured to provide means for mounting an implement. An implement draft bar 20 is secured by vertical brackets 21 to lateral flanges 22 formed on the plates 19. This construction has not been described in detail, as it forms a part of the present invention only as illustrating an implement mounted at the front end of a tractor.

A beam 23 is pivotally connected by means of brackets 24 to the draft member 20. An imple-

ment frame structure 25, which carries soil engaging elements, is supported by the beam 23. An upwardly extending plate 26, which is a part of the frame structure 25, provides attaching means for lifting the implement.

A link 27, pivotally connected to the upper end of the plate 26, is also pivotally connected to an upstanding lug 24' on one of the brackets 24. A lifting lever 28 is pivoted at its lower end, as shown in Figure 3, on a pair of spaced lugs 20' on the draft bar 20. At its upper end, the lever 28 is pivoted to a longitudinally extending push bar in the form of a pipe 29. Said push bar, at its rear end, is telescopically received by the end portion of a member 30, which is pivoted to a manually adjustable lever 31. Said lever forms in effect a manually adjustable stop to limit rearward movement of the bar 29.

A spring pressure link 32 is pivotally connected to the plate 26 and to a bracket 33 on a transverse bar 33' secured near the forward end of the bar 29. This construction is conventional and has not been shown and described in detail. It is also to be understood that the draft bar 20 extends across the front of the tractor and that a plurality of implement beams 23 are attached thereto, as is conventional in this art.

A lifting member in the form of an inverted ball 34 is pivoted at its ends on the lugs 20' on the same axis as the lifting lever 28. Said ball is provided with a transverse stop 35 which engages the rear side of the lifting lever 28 near its upper end. The ball is also provided with a rearwardly extending ear 36, to which a piston rod 37 of a hydraulically operated cylinder is pivotally connected.

The hydraulic cylinder 38, as shown in Figure 5, is of the pressure type, fluid being admitted under pressure through a coupling 39 at one end of a piston head 40. At the other side of the piston 40 at the other end of the cylinder, a bleed opening 41 has been shown for the escape of liquid leaking past the piston 40. Said passage may be controlled by a check valve 42 to prevent the free flow of air into the cylinder during reciprocation of the piston.

The cylinder 38 is pivotally mounted on a bracket 43 rigidly secured to the tractor frame. At the rear end of the tractor, a vertical attaching bracket 44 has been illustrated, as well as a rearwardly extending plate 45. An implement beam 46 is pivoted to the bottom end of the bracket 44. A frame structure 46', secured to the beam 46, provides means for supporting soil engaging units. A pressure link 47, pivotally secured to the frame structure 46', is connected as illustrated in Figure 2 to a lever arm 48' formed integrally on a transverse rockshaft 48. Said rockshaft is rotatably mounted in the plates 45, it being understood that the construction at each side of the tractor is substantially the same. A quadrant 45', secured to the plate 45, provides means for locking a manually adjustable lever 47' rigidly to the upwardly extending end portion 48' of the rockshaft 48.

A lifting lever 49, rigidly secured to a journal 50 rotatable on the shaft 48, is connected by a lifting link 51 to the frame structure 46'. It will be noted that the lifting link 51 slidably extends through a trunnion-block 52 pivoted on the lifting lever 49. An adjustable stop 52' at the upper end of the link 51 determines the point at which lifting effort is applied to move the implement vertically.

A lifting cylinder 53 is pivoted on a bracket 54,

mounted on the transmission casing 11. The piston rod 53', extending from said cylinder, is pivotally connected to the lifting lever 49, as best shown in Figure 2. As this lifting unit must reduce its over-all length to lift the rear unit, this cylinder moves under pressure in a direction opposite to the cylinder shown in Figure 5. Otherwise, it may be of the same construction.

As shown by the broken away portion of the transmission casing 10 in Figure 4, a transverse transmission shaft 55 is provided with an end mounting consisting of a ball bearing assembly 56. This assembly is mounted in one end portion of a housing 57, which supports a pump driving shaft 58 arranged in axial alignment with the shaft 55. The pump driving shaft 58 is driven from a nut 59 on the end of the transmission shaft 55 by means of a member 60 keyed to the shaft 58 and formed with a driving portion engaging the nut 59.

The housing 57 is enlarged at its outer end and formed with an upper chamber 61 and a lower chamber 62 surrounding the bearing portion for the outer end of the shaft 58. The two chambers are formed by a horizontal partition 63. The enlarged portion of the housing at this point also extends upwardly terminating in a flanged upper surface 64. The chamber 61, which is the high pressure side of the pump, communicates with a passage 65 terminating at the surface 64. The chamber 62, which is at the low pressure side of the pump, is extended upwardly by means of a passage 66, also terminating at the surface 64.

An elliptical pump gear casing 67 is secured to the outer face of the housing 57 adjacent the chambers 61 and 62. One pump gear 68 is keyed to the shaft 58 within the chamber formed by the casing 67. Another pump gear 69, shown in dotted lines in Figure 6, is rotatably mounted on a stub shaft 70. A cover plate 71, secured to the outer face of the casing 67, completes the pump chamber and forms outer journals for the ends of the shafts 58 and 70.

An opening 72, formed in the end wall separating the chamber 62 and the pump chamber, forms a fluid conduit for the delivery of fluid into the pump chamber. A similar opening 73, formed in the end wall separating the chamber 61 and the pump chamber, forms an outlet for the delivery of fluid under pressure into the high pressure chamber and therefrom through the passage 65.

A control housing 74 is formed with a surfaced lower face 75, which is seated on the face 64 of the pump housing. Adjacent the face 75, the housing 74 is cored to provide the necessary passages for fluid distribution. As shown best in Figures 6 and 8, the discharge passage 65 from the pump housing communicates with a passage 76 cored into the control housing from the lower wall thereof. The passage 76, as best shown in Figure 8, is formed with branches 77, 78 and 79. Said branches terminate in alignment with each other to provide for control valves positioned in a single line, whereby a single cam shaft may be utilized for their operation.

Valve stem guides 80, extending upwardly above the terminal ends of the branches 77, 78 and 79, form guiding means, respectively, for valves 81, 82 and 83. Said valves are provided with conventional valve springs 84 and spring retainers 85, whereby the valves are urged in an upward direction.

A transverse cam shaft 86 is mounted in the housing 74 supported at each end by removable journal members 87. Said shaft is provided with

cams 88, 89 and 90 positioned to contact, respectively, the stems of the valves 81, 82 and 83.

Adjacent the ends of the branch conduits 77, 78 and 79, openings 91, 92 and 93 are formed corresponding respectively with the branches 77, 78 and 79. The valve stems operate poppet valves to control fluid discharge through the openings 91, 92 and 93.

The valve 81 controls fluid communication with a passage-way 97 cored in the upper portion of the pump casing adjacent the contact surface 64. Said passage, as shown in Figure 4, communicates with a discharge opening adapted to be connected with a fitting 95, as shown in Figure 1, for delivering fluid through a conduit 96 to the cylinder 53 at the rear of the tractor.

The valve 83 controls fluid flow through a passage-way 94 adapted to be connected by means of a fitting 98 with a conduit 98' for supplying fluid to the fitting 39 on the cylinder 38 at the front end of the tractor.

The valve carried by the central valve stem 82 controls fluid flow between the central branch 78 and the low pressure passage 66 leading to the inlet side of the pump. This valve may be, therefore, considered as the by-pass valve. When it is opened, as shown in Figure 6, pressure is released from the pump. In connection with the above description of the passage-ways 94 and 97, attention is called to the section line on Figure 6, which cuts across the dividing wall between the low and high pressure sides of the pump. This section accounts for the peculiar appearance of the chamber in Figure 4.

A ratchet member 99, as shown alone in Figure 9, is rotatably mounted on the cam shaft 86 in the position shown in Figure 4. Said member has one lever arm 99' on which a pawl 100 is pivotally mounted. A compression spring 101 abuts a recess formed in the pawl 100 and a recess formed in an over-hanging extension 102 of the arm 99'. Said spring, therefore, urges the pawl 100 toward the cam shaft.

Adjacent the ratchet member 99, a notched flange 103 is formed on the cam shaft 86. Five circumferentially spaced notches 104 are formed on said flanges. As best shown in Figure 6, the notches have a face lying on a radius on the flange against which the pawl 100 abuts and a cam extending in the other direction.

The ratchet member 99 is formed with an actuating arm 105. Said arm is formed with an integral laterally extending end portion 106 positioned to abut stops 107 and 108 cast on the housing, to limit angular movement of the ratchet member in both directions.

The actuating arm 105 of the ratchet member 99 is provided with an opening 109, into which the bent-over end of an actuating rod 110 is pivoted. A cotter-key holds said end in position. The other end of the actuating rod is similarly secured to a lever arm 111 rigidly clamped on an actuating shaft 112. Said shaft extends through the wall of the casing to form a means for connecting an operating lever 113.

At each movement of the actuating shaft, the pawl 100 rotates the cam shaft one-fifth of a complete revolution in the direction shown in Figure 6. As shown in Figure 7, a tension spring 114 is connected to an ear 115 formed on the housing 74 and to a pin 116 formed on a member 117 clamped to the actuating shaft 112. Said spring returns the actuating mechanism to its original position after operation to rotate the cam shaft one-fifth of a revolution.

As also shown in Figure 7, a spring pressed latch 118, mounted in a hollow boss 119 formed on the housing wall, is adapted to engage notches formed in a flange 120 mounted on the cam shaft adjacent one end. The notches in said flange are positioned to be engaged by the plunger 118 to hold the cam shaft in any of the positions to which it is moved by operation of the actuating shaft 112.

In the operation of the device above described, the gear pump is continuously operated by means of the pump shaft 58 and its connection with the continuously rotating transmission shaft 55. Liquid taken in from the low pressure chamber 62 through the opening 72 into the pump chamber 15 is delivered at high pressure from the pump chamber through the opening 73 into the high pressure chamber 61. By means of the passage-ways 65 and 76, liquid is supplied under pressure to the three branches 77, 78 and 79.

The central valve 82 is shown in the position illustrated as being held open by the central cam 89. There is, therefore, no back pressure on the pump and it runs idle without the use of any appreciable power. Assuming that the operator moves the actuating shaft 112 for a complete movement of the ratchet member 99, the pawl 100, in engagement with one of the notches 104, rotates the cam shaft an angular distance of one-fifth of a complete revolution. It will be noted that Figure 10 shows a portion of the cam shaft 86 with the cams 88, 89 and 90 thereon; and the valves 81, 82 and 83. This figure shows the valves in the same position as Figure 4, omitting the valve springs and other parts to diagrammatically illustrate, in combination with Figures 11 to 14, inclusive, the entire cycle of operation of the cam shaft. Figures 15, 16 and 17, which are taken on the section lines bearing the corresponding numbers on Figure 10, show the cams in their position with the by-pass valve 82 open. In the description, this position will be designated as position "A" of the cam shaft. The succeeding positions, as labeled in Figures 15, 16 and 17, will be identified as positions B, C, D and E in the order named. Figure 10, then, corresponds to position A; Figure 11 corresponds to position B; Figure 12 corresponds to position C; Figure 13 corresponds to position D; and, Figure 14 corresponds to position E.

By movement of the cam shaft an angular distance of one-fifth of a complete revolution, the cams are brought into position B, as illustrated in Figure 11. In this position, the points B, as identified in Figures 15, 16 and 17, lie over the stems of the valves. During rotation to position B, the cam 90 engages and opens the valve 83, thereby allowing liquid to flow from the front lifting cylinder through the passage-way 94 back to the low pressure side of the pump. The implements at the front of the tractor are lowered during this step of the operation.

When the cam shaft is moved another one-fifth of a revolution, position C is attained, as shown in Figure 12. The cam 88 has rotated around in this position to open the valve 81, thereby allowing flow from the lifting cylinder back through the conduit 96 and the passage-way into the branch 77 and therefrom back to the low pressure side of the pump. By this step in the operation of the control device, the rear implement is lowered. It will be noted in Figure 12 that the valve 83 remains open during the opening of the valve 81, thereby continuing the lowering action of the front cylinder, if it has not al-

ready been completed. The position shown in Figure 12 is, in a sense, a neutral position, as front and rear implements are lowered and as there is no back pressure on the pump.

5 When the cam shaft is moved another step in its operation, the cams 88 and 89 move away from the valves 81 and 82, thereby closing said valves. The cam 90, however, is shaped to hold the valve 83 open. With the by-pass valve 82 closed, pressure is supplied to the conduit 76 and to the branch conduit 79, whereby liquid under pressure is delivered through the passage-way 94 and the conduit 98' to the front lifting cylinder. The front implement is raised to a lifted position while the control shaft is in the position shown in Figure 13.

When the control shaft is moved another step in its operation to position E, as illustrated in Figure 14, the valve 83 is closed by movement of the cam 90, and the valve 81 is opened by contact with the cam 88. Fluid under pressure is thereby supplied through the passage-way 95 and the conduit 96 to the rear lifting cylinder whereby the rear implement is raised to a lifted position. After completion of the rear lifting operation, the cam shaft is moved another one-fifth of the revolution to position A, as shown in Figure 10, thereby completing the entire cycle of operation. The implements, both front and rear, are in lifted position with the by-pass valve 82 open whereby there is no back pressure developed on the pump.

It is to be understood that applicants have shown and described only a preferred embodiment of their improved hydraulic power lift and controlling means, and that they claim as their invention all modifications falling within the scope of the appended claims.

What is claimed is:

1. A hydraulic control device, a casing, a fluid pump in the casing, an outlet conduit from said pump, said casing being formed with three valve chambers, each of said chambers being in communication with the pump outlet, three valves positioned to control fluid flow from said chambers, one of said valves controlling flow to a hydraulic device, a second of said valves controlling flow to a second hydraulic device, and a third valve controlling return flow to the inlet of the pump, a cam shaft rotatably mounted in the casing, means for rotating said cam shaft a predetermined angular distance at each step of its movement, a cam on the shaft for each of the control valves, said cams being positioned at angles relative to each other and being provided with faces operable to successively open the two valves to the hydraulic devices, open the third valve to by-pass the fluid from the pump, and to successively open the other two valves while said valve remains open to by-pass fluid from the two hydraulic devices to the low pressure side of the pump.

2. A hydraulic control device for implement power lifts having a plurality of lifting cylinders connected to implements carried by a tractor comprising a casing on the tractor, means in said casing for engaging a drive element of the tractor, a fluid pump in the casing operable by said means, an outlet conduit from said pump, three valve chambers in communication with said conduit, valves positioned to control fluid flow through said chambers, a conduit connecting one of said chambers with one of the lifting cylinders, a conduit connecting another of said chambers with a second lifting cylinder and a by-pass conduit connecting the third chamber with the

inlet side of the pump, a cam shaft rotatably mounted in the casing, means for moving said cam shaft a predetermined number of degrees at each of the five steps of movement, spring pressed latch means in engagement with said shaft operative to hold the shaft in any one of its adjusted positions, and a cam on the shaft for each of the control valves, said cams being positioned at angles to each other and being provided with faces operable to successively open the two valves to the power lift devices, to by-pass the fluid to the pump, and to successively by-pass fluid from the two power lift devices to the pump.

3. A hydraulic control device for implement power lifts having a plurality of lifting cylinders connected to implements comprising a casing on the tractor, means in said casing for engaging a drive element of a tractor, a fluid pump in the casing operable by said means, an outlet conduit from said pump, said casing being formed with three valve chambers in communication with said conduit, a valve controlling fluid flow from each of said chambers, one of said valves controlling flow to one of the lifting cylinders, a second of said valves controlling flow to a second lifting cylinder and a third valve controlling return flow to the low pressure inlet side of the pump, a cam shaft rotatably mounted in the casing, means for moving said cam shaft a predetermined number of degrees at each of the five steps of its movement, and a cam on the shaft for each of the control valves, said cams being positioned at angles relative to each other and being provided with faces operable to successively open the two valves to the power lift cylinders for lifting the implements, to by-pass the fluid from the pump, and to successively by-pass fluid from the two power lift cylinders to the low pressure side of the pump for lowering the implements.

4. A hydraulic control device for implement power lifts having a plurality of lifting cylinders connected to implements carried by a tractor comprising a casing on the tractor, means in said casing for engaging a drive element of a tractor, a fluid pump in the casing operable by said means, an outlet conduit from said pump, said casing being formed with three valve chambers in communication with said conduit, a valve controlling fluid flow from each of said chambers, one of said valves controlling flow to one of the lifting cylinders, a second of said valves controlling flow to a second lifting cylinder and a third valve controlling return flow to the low pressure inlet side of the pump, a cam shaft rotatably mounted in the casing, manually operated ratchet means for moving said cam shaft in one direction only a predetermined number of degrees at each of the five steps of its movement, and a cam on the shaft for each of the control valves, said cams being positioned at angles relative to each other and being provided with faces operable to successively open the two valves to the power lift cylinders for lifting the implements, to by-pass the fluid from the pump, and to successively by-pass fluid from the two power lift cylinders to the low pressure side of the pump for lowering the implements.

5. A hydraulic control device for implement power lifts having a plurality of lifting cylinders connected to implements carried by a tractor comprising a casing on the tractor, means in said casing for engaging a drive element of the tractor, a fluid pump in the casing operable by said means, an outlet conduit from said pump, said

casing being formed with three valve chambers in communication with said conduit, valves positioned to control fluid flow through said chambers, a conduit connecting one of said chambers with one of the lifting cylinders, a conduit connecting another of said chambers with a second lifting cylinder and a by-pass conduit connecting the third chamber with the inlet side of the pump, a valve operating cam shaft rotatably mounted in the casing, manually operated ratchet means for moving said cam shaft in one direction only a predetermined number of degrees at each of the five steps of its movement, and a cam on the shaft for each of the control valves, said cams being positioned at angles relative to each other and being provided with faces operable to successively open the two valves to the power lift devices, to by-pass the fluid to the pump, and to successively by-pass fluid from the two power lift devices to the pump.

6. A hydraulic control device comprising a casing formed with three communicating valve chambers to which fluid is to be supplied under pressure, three valves positioned to control fluid flow from said chambers, one of said valves controlling flow to a hydraulic device, a second of said valves controlling flow to a second hydraulic device and a third valve forming a by-pass and relief valve, a cam shaft rotatably mounted in the casing, means for rotating said cam shaft a predetermined angular distance at each step of its movement, and a cam on the shaft for each

of the control valves, said cams being positioned at angles relative to each other and being provided with faces operable to successively open the two valves to the hydraulic devices, open the by-pass valve, and to successively open the other two valves while said by-pass valve remains open to provide for return flow of fluid from the two hydraulic devices.

7. A hydraulic control device comprising a casing formed with three communicating valve chambers to which fluid is to be supplied under pressure, three valves positioned to control fluid flow from said chambers, one of said valves controlling flow to a hydraulic device, a second of said valves controlling flow to a second hydraulic device and a third valve forming a by-pass and relief valve, a cam shaft rotatably mounted in the casing, manually operated ratchet means for rotating said cam shaft a predetermined angular distance at each of the five steps of its movement to complete one revolution, and a cam on the shaft for each of the control valves, said cams being positioned at angles relative to each other and being provided with faces operable to successively open the two valves to the hydraulic devices, open the by-pass valve, and to successively open the other two valves while said by-pass valve remains open to provide for return flow of fluid from the two hydraulic devices.

EDWARD A. JOHNSTON.
ALEXUS C. LINDGREN.