Jan. 10, 1939. H. O. DAY 2,143,546

HYDRAULIC HOISTING SYSTEM AND CONTROL WITH APPARATUS THEREFOR

Filed March 9, 1936 4 Sheets-Sheet 1

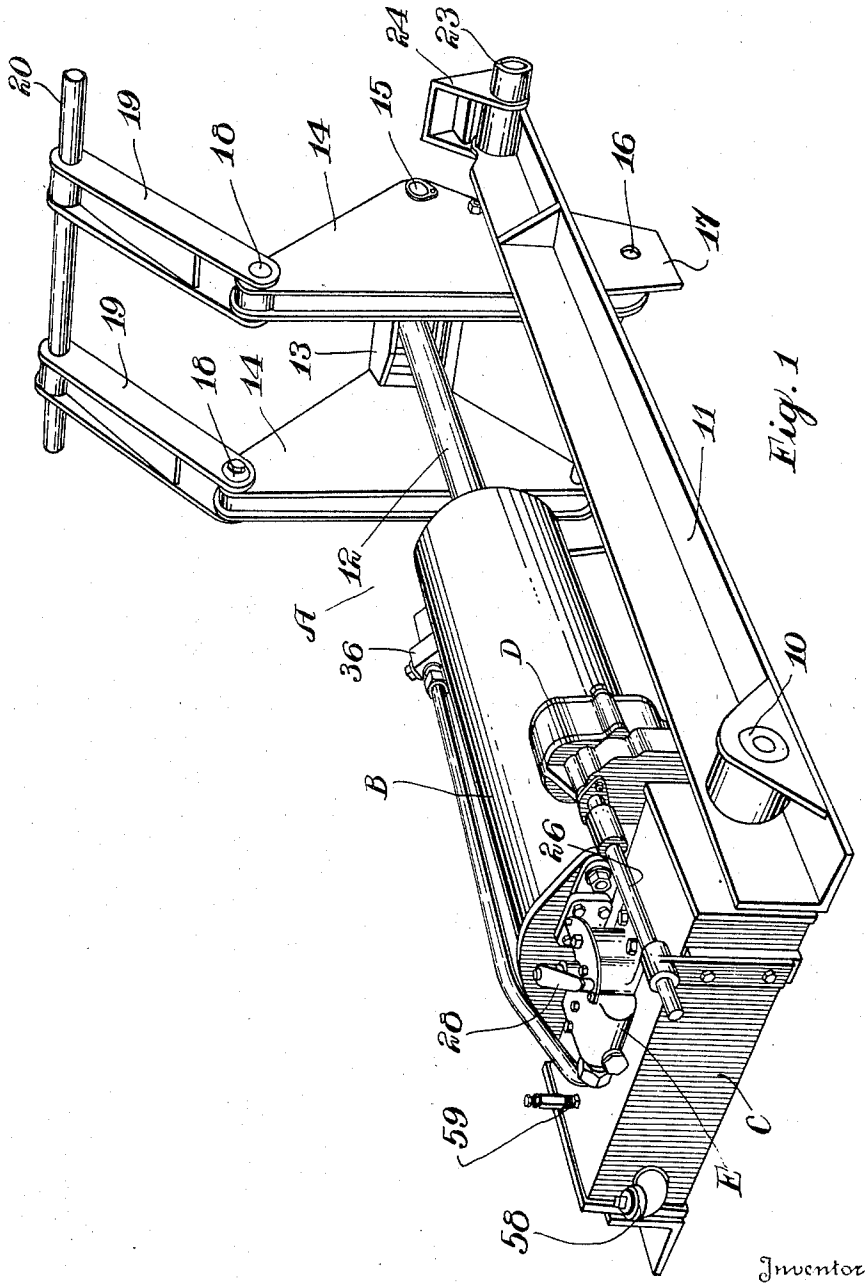

Fig. 1

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HYDRAULIC HOISTING SYSTEM AND CONTROL WITH APPARATUS THEREFOR

Filed March 9, 1936 4 Sheets-Sheet 2

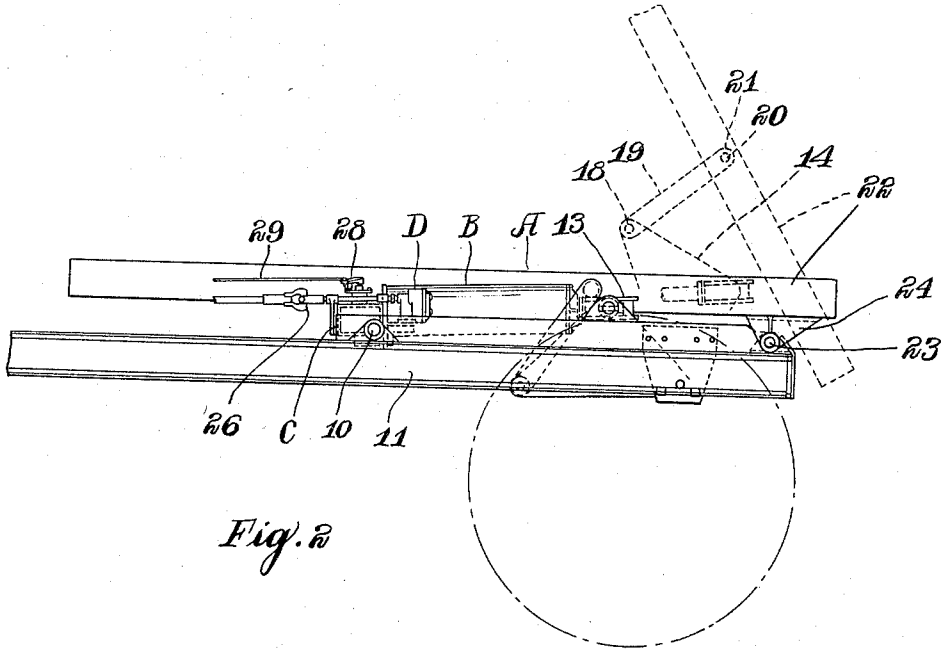

Fig. 2

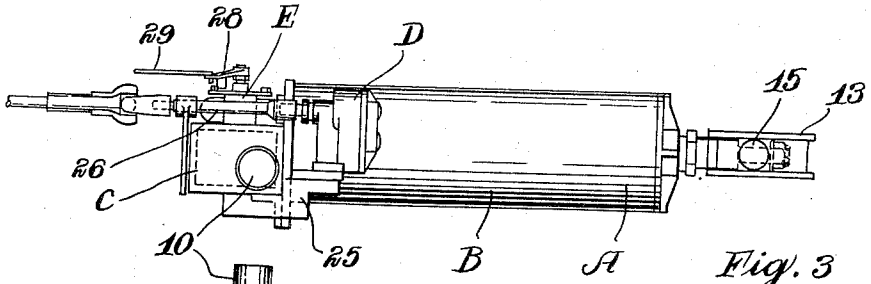

Fig. 3

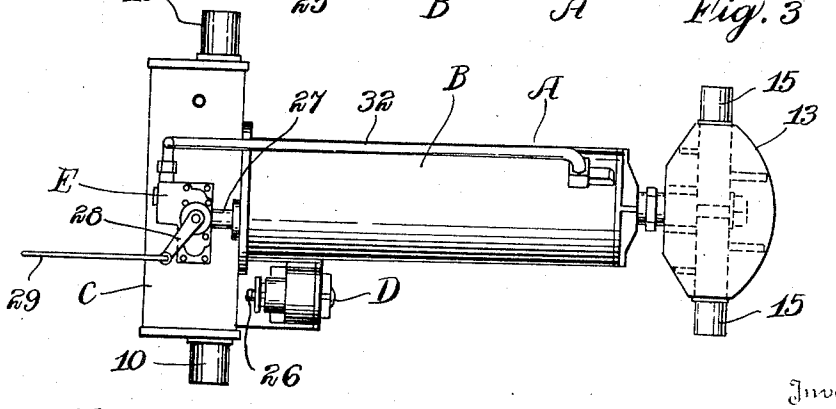

Fig. 4

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HYDRAULIC HOISTING SYSTEM AND CONTROL WITH APPARATUS THEREFOR

Filed March 9, 1936 4 Sheets-Sheet 3

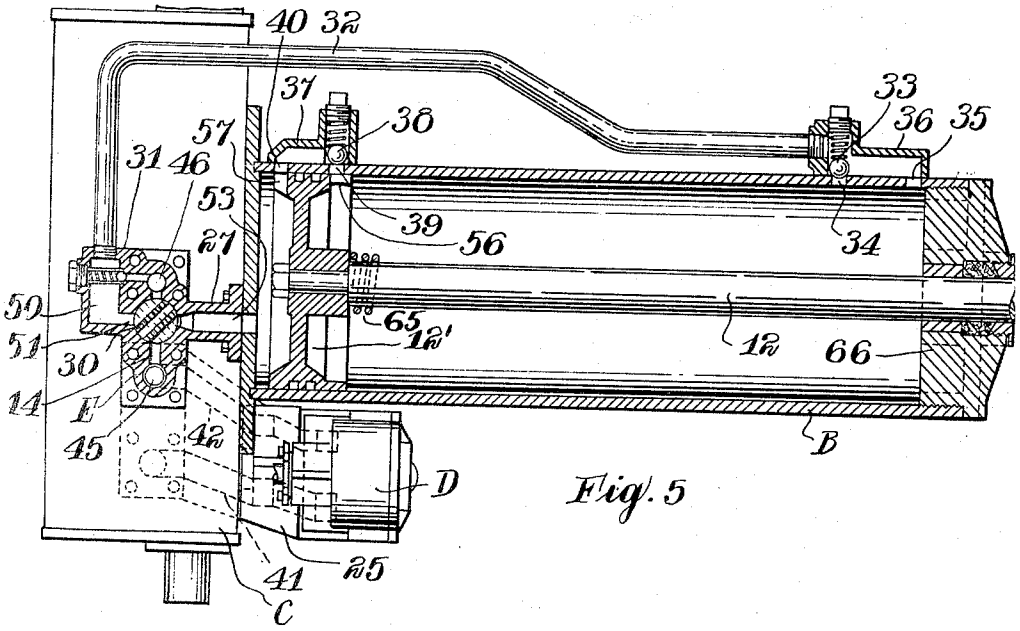

Fig. 5

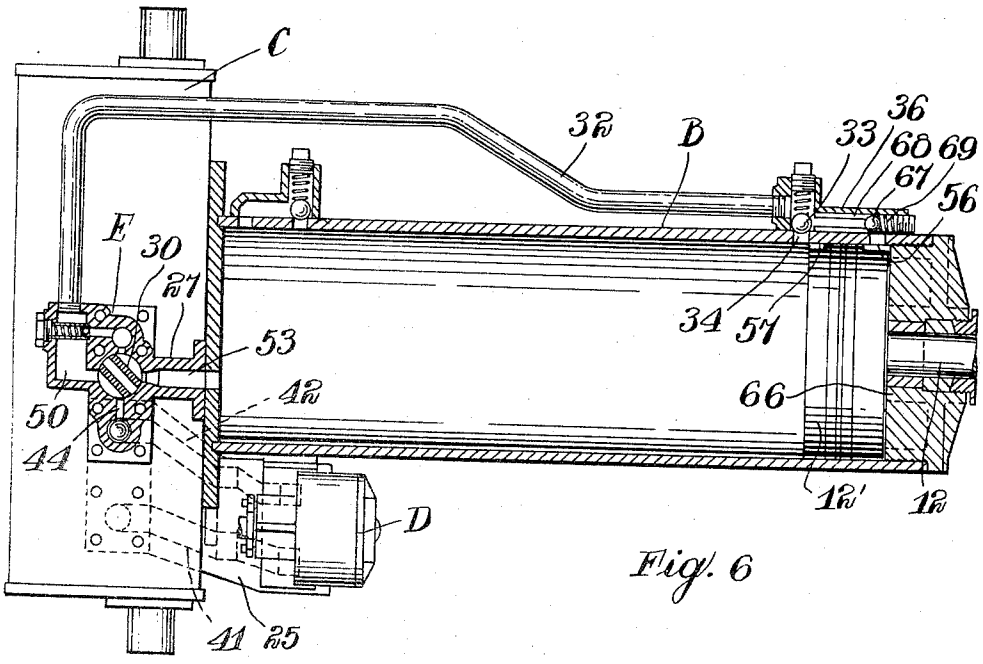

Fig. 6

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HYDRAULIC HOISTING SYSTEM AND CONTROL WITH APPARATUS THEREFOR

Filed March 9, 1936 4 Sheets-Sheet 4

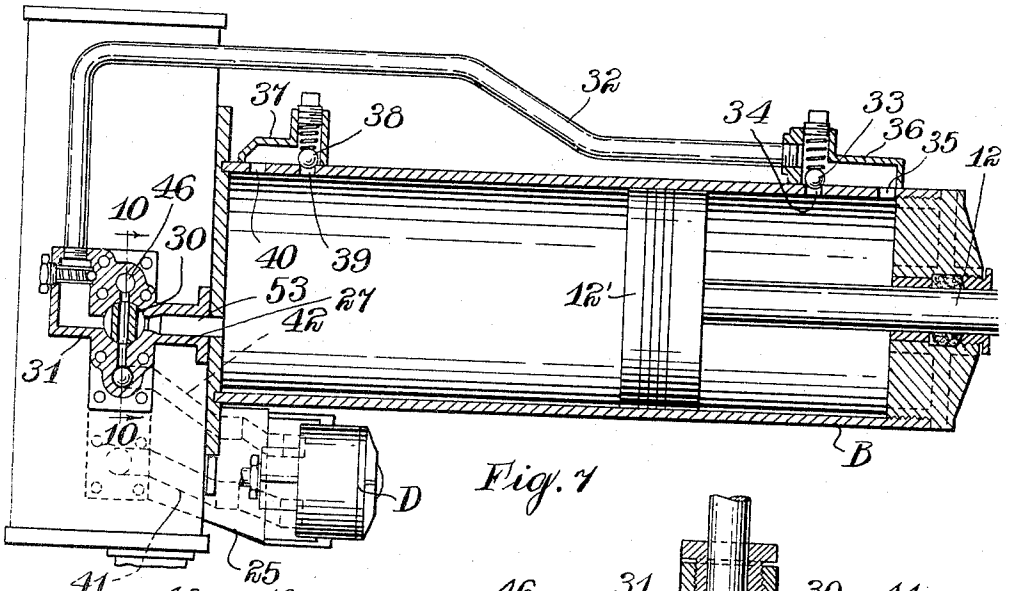

Fig. 7

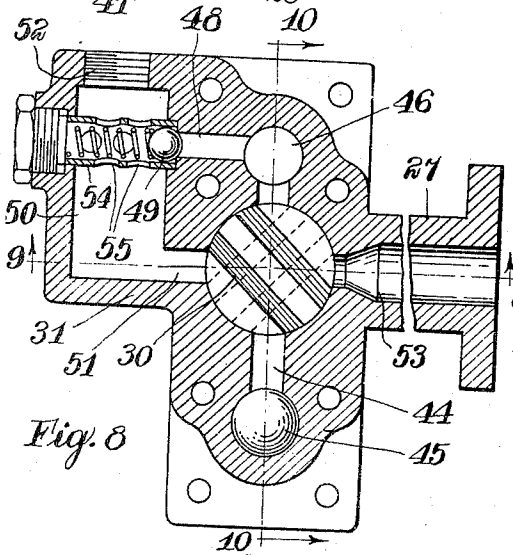

Fig. 8

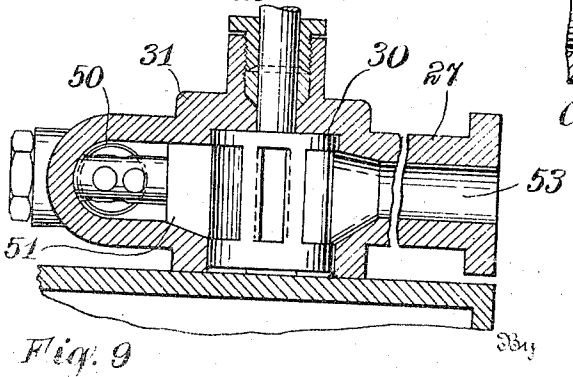

Fig. 9

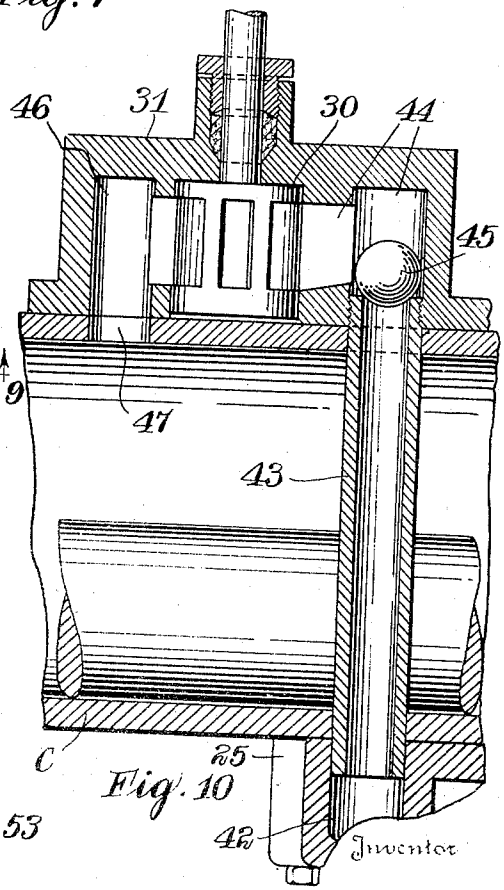

Fig. 10

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Patented Jan. 10, 1939

2,143,546

UNITED STATES PATENT OFFICE

2,143,546

HYDRAULIC HOISTING SYSTEM AND CONTROL WITH APPARATUS THEREFOR

Herbert O. Day, St. Paul, Minn., assignor to St. Paul Hydraulic Hoist Co., Minneapolis, Minn., a corporation of Michigan

Application March 9, 1936, Serial No. 67,763

6 Claims. (Cl. 298—22)

This invention relates to a hydraulic hoisting system and control with the apparatus for carrying out the operation of the system. This hydraulic hoisting system is used primarily in hoisting vehicle dumping bodies to provide a system of hoisting the dump body into a high dumping angle so that the contents of the body will more readily slide out of the same.

A feature resides in providing a hydraulic hoisting system and control means wherein the operation is of a simple character, and which is designed with apparatus adapted to cause the strain to be carried in line with the supporting frame, and providing a self-adjusting operating cylinder means which operates the connecting levers to move the body into and out of dumping position with a balanced and equalized strain on the respective working parts.

Further, this hydraulic hoisting system is provided with control means which includes a master valve together with check valve means for directing the operating fluid in a manner to cause the hydraulic system to operate a dumping body into a high angle, and at the same time cushioning the operation of the dumping action of the body when the center of gravity of the load of the dumping body is shifted to a point where the load has a tendency to work against the elevating action of the hydraulic system.

The system includes a reservoir for the fluid, a pump, a connecting means for operating the pump by the motor which propels the motor vehicle or truck, a master valve means, by-pass passageways, and check valve means which are associated and connected together in a manner to operate the piston of the hydraulic hoisting power cylinder to raise a heavy load in a dumping body into dumping position, to stop the raising of the dumping body in any desired position, and to cushionally control the elevation and lowering by the hydraulic hoisting system in a manner to relieve the strain on the chassis as well as the supporting frame of the apparatus for carrying out the hydraulic hoisting system.

The system further includes the close association and connection of the reservoir for the hydraulic fluid to the power cylinder so as to support the power cylinder by the reservoir and to permit the control valve to be supported by the reservoir in close proximity to the power cylinder, and to provide a close attachment and connection for the hydraulic pump which is adapted to move the fluid in a manner to operate the piston of the power cylinder.

Further, the system includes the apparatus for carrying out the hydraulic hoisting system which is of a unitary character, compact in nature, and adapted to be folded in a small space beneath the dumping body which is adapted to be hoisted by the apparatus and the operation of the system.

The features will be defined more in detail.

In the drawings:

Figure 1 illustrates a perspective of the apparatus used in my hydraulic hoisting system and control, showing the same diagrammatically as a unit, detached from the chassis and the dumping body of a motor vehicle.

Figure 2 is a diagrammatic side elevation of a portion of a motor vehicle chassis of a dump truck and indicating the beam for supporting the dumping body above the apparatus of the hydraulic hoisting system and control, showing the same also in high elevated position in dotted outline.

Figure 3 is a side view of the apparatus for my hydraulic hoisting system and control.

Figure 4 is a plan view of the apparatus illustrated in Figure 3, showing the unit apart from the motor vehicle chassis.

Figure 5 is an enlarged plan longitudinal sectional view of the power cylinder and a portion of the control valve.

Figure 6 is a similar section to Figure 5, showing the parts in a different position.

Figure 7 is another similar enlarged section to Figures 5 and 6, showing the parts in still another position.

Figure 8 is an enlarged section of the control valve.

Figure 9 is a section on the line 9—9 of Figure 8.

Figure 10 is an enlarged sectional detail through a portion of the reservoir tank beam and the control valve mounted on the same, on the line 10—10 of Figures 7 and 8.

My hydraulic hoisting system and control is illustrated with the apparatus for carrying out the same and I have shown the same as it appears in a unit A, which includes a power cylinder B, a hydraulic reservoir tank beam C at one end of the cylinder B, which pivotally supports the cylinder B by the trunnions 10 which project from the ends of the tank beam C to the longitudinally extending unit apparatus supporting frame members 11. The piston rod 12 of the cylinder B is connected by the cross-head 13 to the plate levers 14 by the cross-head trunnions 15, while the plate levers 14 are pivoted by the shaft 16 to the depending frame portions 17 which depend from the longitudinal frame members 11.

The plate levers 14 are also pivotally con-

nected at 18 to the links 19 which extend from the plate levers 14 and are connected to the shaft 20 which is pivotally connected at 21 to the longitudinal beams 22 upon which the dumping body is mounted, the dumping body not being illustrated in the drawings. The beams 22 are pivotally connected at 23 to the bracket members 24 at the rear portion of the frame members 11 so that the dumping body may be elevated to a high angle by the hydraulic hoisting system and control with the apparatus illustrated to cause the contents of the dumping body to readily slide out of the same.

The unit A of my hydraulic hoisting system and control includes a gear pump D which is mounted on the bracket 25 to support the pump D to and in close proximity to the tank beam C. The gear pump D is adapted to be operated by the shaft 26 which extends and is adapted to be connected to the power unit for propelling the motor vehicle. Only a portion of the shaft 26 and the connections with the power unit of the motor vehicle are shown in the drawings; neither is the power unit shown in the drawings for the motor vehicle, this ordinarily being the internal combustion engine which drives the motor vehicle upon which my hydraulic hoisting system and control and apparatus therefor is used.

The unit A includes a control valve E mounted upon the tank beam C and connected in close proximity to the cylinder B by the tubular member 27. The valve E is adapted to be controlled by the lever 28 which is operated by the rod 29, only a portion of which is illustrated. The operation of the lever 28 controls the position of the valve member 30 within the casing 31 of the valve E.

The valve E is connected by the pipe 32 to one end of the cylinder B which connects with the check valve 33 that closes the opening 34 into the cylinder B and also connects with the opening 35 into the cylinder B from the manifold 36 which supports the check valve 33.

The cylinder B is provided with a manifold 37 which is positioned at the opposite end to the manifold 36 and which is adjacent the tank beam C. The manifold 37 supports the check valve 38 which closes the passageway 39 into the cylinder B. The manifold 37 also provides a connection through the passageway 40 into the cylinder B.

The piston rod 12 is adapted to be operated by the piston 12' which operates back and forth within the cylinder B in accordance with the position of the valve 30 and the operation of the pump D as will be hereinafter more fully set forth. The pump D is connected to the tank beam C by the manifold bracket 35 in which the passageway 41 is formed to connect the pump D with the tank beam C to supply the fluid from the tank beam C to the pump D. A second passageway 42 is formed in the manifold 25, which connects with the pipe 43 extending through the tank C and connecting with the manifold passageway 44 in the casing 31 of the valve E. A ball check 45 is provided at the top of the pipe 43 to check the flow of liquid back through the pipe 43.

The valve E is provided with a passageway 46 formed in the casing 31 on the opposite side of the valve 30 to the passageway 44 which is adapted to connect through the passageway 47 directly into the beam tank C. A by-pass 48 is formed extending from the upper portion of the passageway 46 and which is adapted to connect through the check valve 49 into the manifold passageway 50 in the casing 31. The manifold passageway 50 is connected with the valve 30 through a passageway 51 on one end and on the other end is connected through the passageway 52 to the pipe 32. A passageway 53 is formed through the tubular portion 27 which connects the valve 30 with the cylinder B. The check valve 49 is held by a coil spring to normally close the passageway 48, and the coil spring is mounted within a tubular support 54 which is provided with suitable perforations 55 to admit fluid under pressure to hold the valve 49 closed and to also permit the valve 49 to open when pressure of the fluid from the passageway 48 operates against the valve 49.

In operation my hydraulic hoisting system and control is designed to elevate the dumping body of an automobile or motor vehicle into a high angle so that the contents of the same will readily slide out of the elevated body. The system includes a control means for stopping the hoisting of the dumping body at any angle between the normal horizontal position of the dumping body and the uppermost dumping position, and to control the lowering of the hoisted body to hydraulically cushion the lowering operation to take any undue shock off of the operating parts and to provide a reliable hydraulic hoisting means, as well as providing by-pass releasing means in the control system. The apparatus used in carrying out my system is of a very compact nature. The operation of my hydraulic hoisting system resides in operating the gear pump D by the shaft 26, and when it is desired to elevate the dumping body supported upon the beams 22, the valve 30 is set in the position illustrated in Figure 5, while the gear pump D is in operation. Thereupon the gear pump D will draw the oil or other fluid from the beam tank C through the passageway 41 into the gear pump which will in turn eject the fluid from the gear pump, through the passageway 42, up through the pipe 43 and past the ball check 45, through the passageway 44 to the valve 30. The fluid passes from the passageway 44 through the valve 30 and through the passageway 53 of the manifold connection 27 into the cylinder B under pressure, causing the piston 12' to push the piston rod 12 out of the cylinder B. This operation causes the cross-head 13 to move away from the cylinder, operating the plate levers 14 and the links 19 to move into the position as illustrated in Figure 1 and also in dotted lines in Figure 2, thus raising the beams 22 into the dotted line position of Figure 2 to elevate the dumping body of the vehicle on the beams 22 into a high dumping angle.

The gear pump D may continue to operate after the piston 12' reaches the limit of its stroke in the cylinder B, as illustrated in Figure 6, owing to the relief valve 33 permitting the fluid pressure to return through the pipe 32 back to the manifold passages 50 and 51 in the valve casing E, then through the passageway in the valve 30 and through the passageways 46 and 47 back into the beam tank C.

To lower the dumping body and to move the piston 12' from its outer position, the valve 30 is rotated into the position illustrated in Figure 6, whereupon if the pump D is operating, the fluid pressure from the passageway 44 will pass through a passageway in the valve 30, then through the passageways 51 and 50, and on through the tube 32, past the check valve 33 to the other side of the piston 12' by reason of the opening 56 in the piston 12', causing the piston to move inwardly

by the pressure on the other side of the same, and back to the position illustrated in Figure 5. Here again, if the gear pump D continues to operate, the pressure is relieved or by-passed through the passageways **56** and **39** around the piston **12'** by the opening of the check valve **38**, permitting the fluid pressure to pass through the manifold **37**, through the passageway **40** and through the passageway **57** in the piston to the other side of the piston **12'**, and then through the passageways **53**, then through the valve **30** and through the passageways **46** and **47**, back into the beam reservoir tank C, as illustrated in Figure 6 and in Figure 10 when the valve **30** is in the position illustrated in Figures 6 and 8. The lowering position of the valve **30** is illustrated in Figure 6 and in Figure 8.

Should the gear pump D be shut off after the dump body has moved from the high dumping angle to a lower position so that the weight of the dumping body will tend to circulate the fluid in the system and the valve **30** is in the position illustrated in Figure 6 or 8, the fluid will be by-passed through the passageway **53**, through the valve **30** and through the passageway **48** opening the check valve **49** so that the fluid may be by-passed back through the pipe **32** and through the manifold **36** and then through the passageway **35** into the cylinder B on the opposite side of the piston **12'**. This permits the piston **12'** to circulate the fluid in the cylinder from one side of the piston to the other without operating the gear pump D. Thus it is apparent that the check valve **49** provides a means of relief for the fluid in the cylinder B so that the dumping body may be lowered without operating the gear pump D.

If it is desired to stop the piston **12'** between the ends of the cylinder B during the operation of the gear pump D, the valve **30** may be placed in the position illustrated in Figure 7. With the control valve **30** in this position, the fluid pressure from the pump D will pass through the passageway **42**, past the check valve **45**, through the port **44**, directly through the center of the valve **30**, through the port **46** and the passageway **47**, back to the reservoir tank beam C, thus by-passing the fluid pressure from the pump D directly back to the reservoir tank and locking the piston **12'** in a set position with fluid on either side of the same.

My hydraulic hoisting system provides the apparatus which is virtually filled with oil or other fluid so that the tank beam C may be filled through the filler plug **58** and air may escape through the plug **59**, the gear pump being operated to fill the cylinder B as well as the connecting passageways with a surplus of fluid in the tank C when the piston **12'** is in its outermost position. Thus I provide a hydraulic hoisting system and control which effectively operates in a simple manner to provide a hoisting means with unitary compact folding members which may be operated and fully controlled in handling dump bodies, the power for the gear pump D being normally supplied through the shaft **26** and such other connections as are not shown, to the power of the internal combustion engine of the motor vehicle.

The unitary nature of the apparatus providing compactness with strength is an essential feature in my hydraulic hoisting system in that it provides a very sturdy construction which will operate under the strain of the hoisting load as well as the vibration and weaving in a motor vehicle, and further the operation of the apparatus being completely cushioned by the hydraulic fluid within the same.

Further, I provide in my hydraulic hoisting system a means of elevating a dumping body to a high angle so that the load will go over the center of gravity to cause the same to be readily discharged out of the dumping body and eliminating the necessity of a tail gate in the dumping body. In elevating the dumping body into an angle throwing the load over the center of gravity, it will be apparent that as the load passes over the center of gravity, a reverse strain will be directed to the hoisting system and I have provided hydraulic means for cushioning the piston in a manner to act as a hydraulic check holding the load in control, thereby cushionally protecting the hoisting mechanism, as well as the dumping equipment and vehicle.

The system further provides a means of directing hydraulic force to the piston in lowering the dumping body from an angle beyond the center of gravity so as to bring the dumping body down by hydraulic pressure, and at all times during raising or lowering, holding the body either loaded or empty, by hydraulic cushioned control.

The check valve by-pass release in the control valve provides an important function in protecting the pump to permit the pump to be cut off, relieving it from the hydraulic pressure in the lowering operation of the body by gravity. The main control valve **30**, however, may be operated to hold the piston **12'** in any desired position in the cylinder B and thus control the operation of the dumping body.

To act as a further check in preventing the body secured to the beams **22** from pulling the piston **12'** toward the right end of the cylinder B as shown in the drawings when the body tilts beyond its center of gravity, I may provide a coil spring **65**, illustrated in Figure 5. This spring acts against the end **66** of the piston when the piston **12'** is pulled by its piston rod **12** by this tilting of the body. A cushion is thus provided which acts to prevent the piston **12'** from striking the end **66** of the cylinder B.

A slightly different form of check is shown in Figure 6. In this form of construction, the manifold **36** is provided with a check valve **67** which seats against longitudinal ribs **68** within the manifold **36**. The check valve **67** is resiliently supported by the spring **69** and permits this ball valve to be forced out of the way of liquid passing through the tube **32** toward the end **66** of the cylinder B. However, the valve **69**, while not seating around its entire circumference, acts to restrict the flow of liquid from the right end of the cylinder B, shown in Figure 6, so that the liquid in this end of the cylinder may only be expelled at a slow rate of speed after the piston **12'** has passed the port **34**. In this way, a hydraulic check is provided by the ball valve **67** by its restriction of the flow of liquid past this valve from the port **56**.

The spaced apart by-pass check valve means associated with the cylinder are of importance in the operation of my hydraulic hoisting system. These by-pass check valves permit the fluid pressure to be directed to either side of the piston **12'**. Thus there are no dead positions for the piston **12'** in the cylinder B. The piston may be controlled and operated hydraulically in any position.

The by-pass check valves in the system perform an important function in the regulation and complete control of the piston in the cylinder B to

carry out the various functions required of the same in handling the dump bodies on motor vehicles or the like.

I claim:

1. A hydraulic hoisting system and control comprising a hydraulic cylinder, a piston having a piston rod, a reservoir tank beam for the hydraulic fluid for operating said piston, a hydraulic pump connected to said reservoir beam, means for operating said pump, a control valve mounted on said reservoir beam in close proximity to said cylinder and having connecting means with said pump, means connecting said control valve to each end of said cylinder to drive said piston in either direction, and by-pass means connected with said cylinder and said control valve whereby said valve will control the operation of the piston to hoist or lower a dumping body during the operation of said pump means, said by-pass means also permitting the lowering of the dump body without the operation of said pump means.

2. A hydraulic hoisting system and control including a hydraulic supply, a cylinder and piston directly associated with said supply, check valve means directly associated with said cylinder, a hydraulic pump, a control valve assembly, and check valve means in said control valve assembly, means connecting said control valve with the cylinder ends to selectively deliver liquid from said pump to either end of said cylinder, whereby said hoisting system may be operated and controlled to operate the piston in said cylinder to raise and lower a dumping body in a manner so that said pump may operate continuously in the raising, lowering, upper and lower positions of the dump body, and so that the dump body may be lowered without operating said pump controlled by said control valve assembly, said check valve means in said control valve assembly opening to permit fluid to by-pass around said pump.

3. A hydraulic hoist including a cylinder, a piston in said cylinder, a hydraulic pressure pump, a valve connected to said pump, means connecting said valve with each end of said cylinder, to selectively conduct high pressure from said valve and pump to one end or the other of said cylinder, means in said valve communicating with the exhaust to connect the end of the cylinder not in communication with high pressure to the exhaust, by-pass means adjacent each end of said cylinder to conduct fluid from the high pressure side of said piston to the low pressure side thereof and means in said by-pass means at one end of said cylinder to restrict the flow of the last portion of fluid from said one end of said cylinder to the exhaust.

4. A hydraulic hoist including a cylinder, a piston in said cylinder, a hydraulic pressure pump, a valve connected to receive fluid pumped thereby, means connecting said valve with each end of said cylinder, said valve being selectively operable to connect one end of said cylinder to high pressure fluid, and to transmit low pressure from the other end of said cylinder to the exhaust, by-pass means adjacent each end of said cylinder to by-pass high pressure around to the low pressure side of said piston, check valve means in each of said by-pass means to prevent the flow of fluid through said by-pass means in one direction and means in one of said by-pass means restricting the flow of fluid in one direction therethrough.

5. A hydraulic hoist comprising a cylinder, a piston therein, a reservoir, a pump connected with said reservoir to receive fluid therefrom, a valve, passages connecting said valve to each end of said cylinder, said valve selectively controlling said passages, a passage from said valve to said reservoir, said valve connecting the end of said cylinder not connected to high pressure to said passage to said reservoir, and by-pass means between said passage to said reservoir and said passage connecting said valve to one end of said cylinder not subjected to high pressure to permit a flow of liquid from said passage to said reservoir to said passage connecting said valve to one end of said cylinder when said reservoir is filled.

6. A hydraulic hoist comprising a cylinder, a piston therein, a reservoir, a pump connected to said reservoir to receive fluid therefrom, a valve connected to receive pressure fluid from said pump, means extending from said valve to each end of said cylinder to conduct fluid from said valve to one end of said cylinder, and to conduct fluid from the other end of said cylinder to said valve, an exhaust passage to said reservoir connected to said valve to receive fluid from the low pressure side of said cylinder, and by-pass means connecting said exhaust passage with one of said means extending from said valve to one end of said cylinder not subjected to high pressure to permit a flow of liquid into said last named means when said reservoir is full.

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