

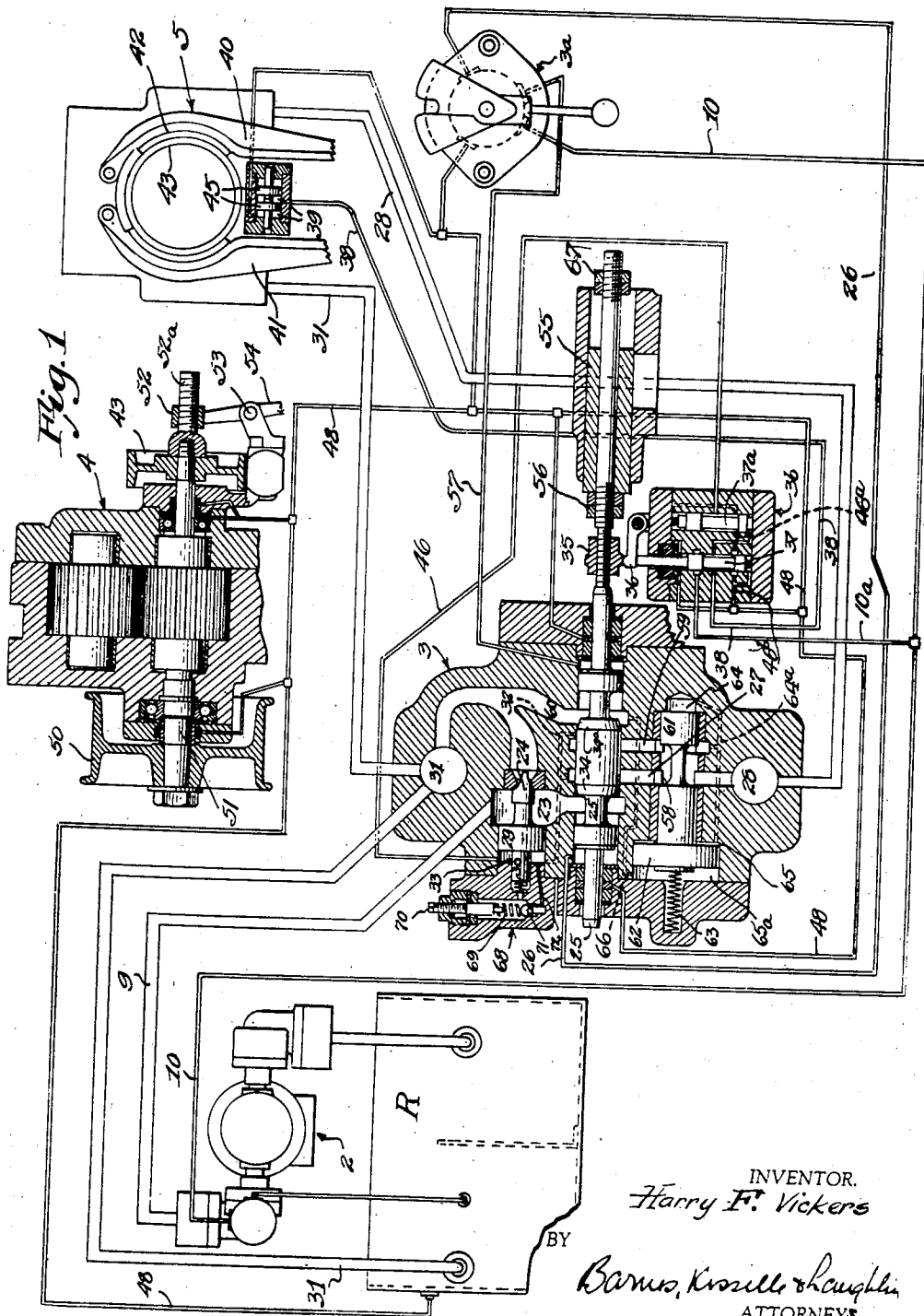
Jan. 11, 1938.

H. F. VICKERS

2,104,780

HYDRAULIC HOISTING UNIT AND CONTROL SYSTEM THEREFOR

Original Filed Sept. 22, 1933 7 Sheets-Sheet 1



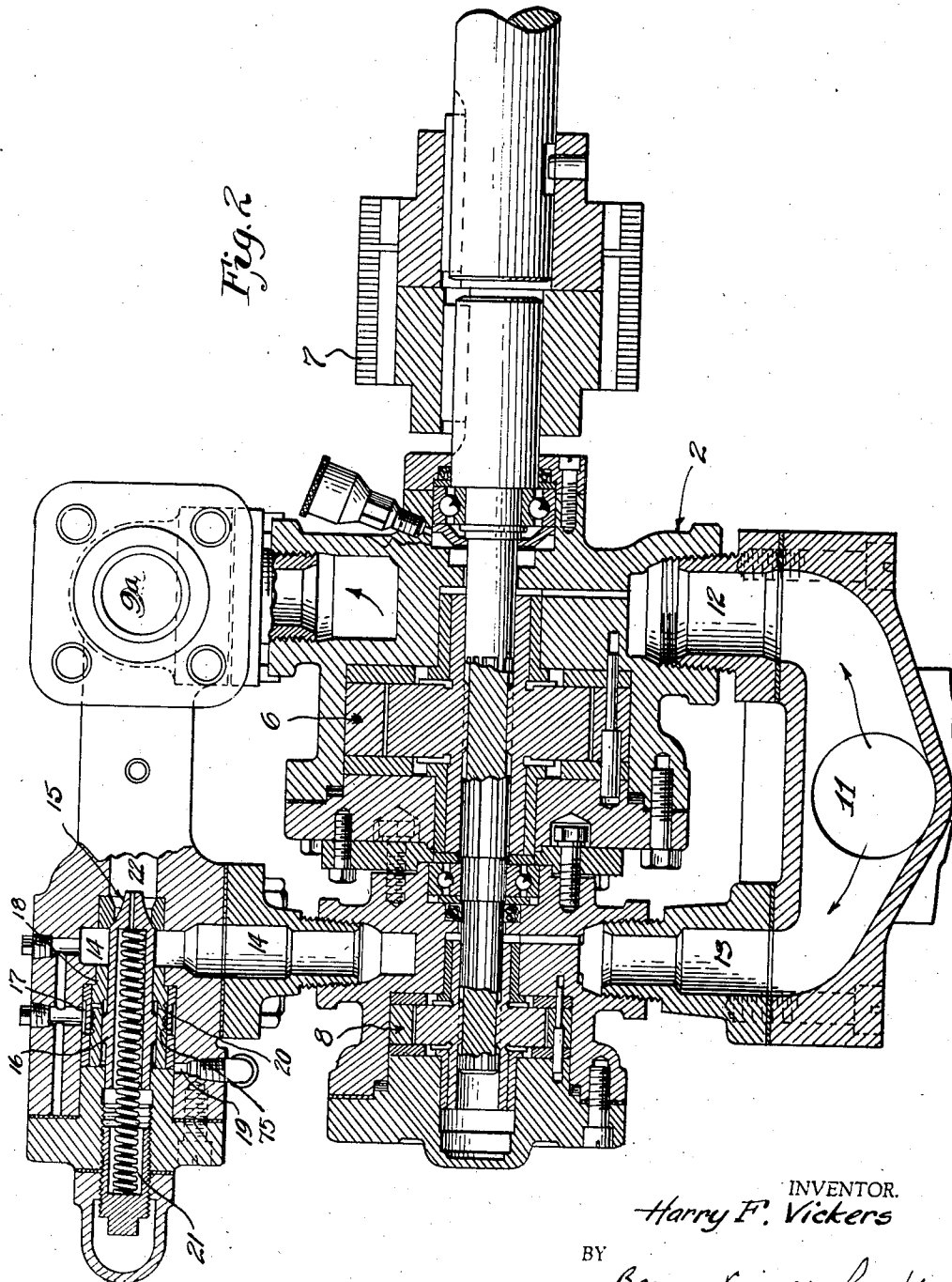
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HYDRAULIC HOISTING UNIT AND CONTROL SYSTEM THEREFOR

Original Filed Sept. 22, 1933 7 Sheets-Sheet 2



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HYDRAULIC HOISTING UNIT AND CONTROL SYSTEM THEREFOR

Original Filed Sept. 22, 1933

7 Sheets-Sheet 3

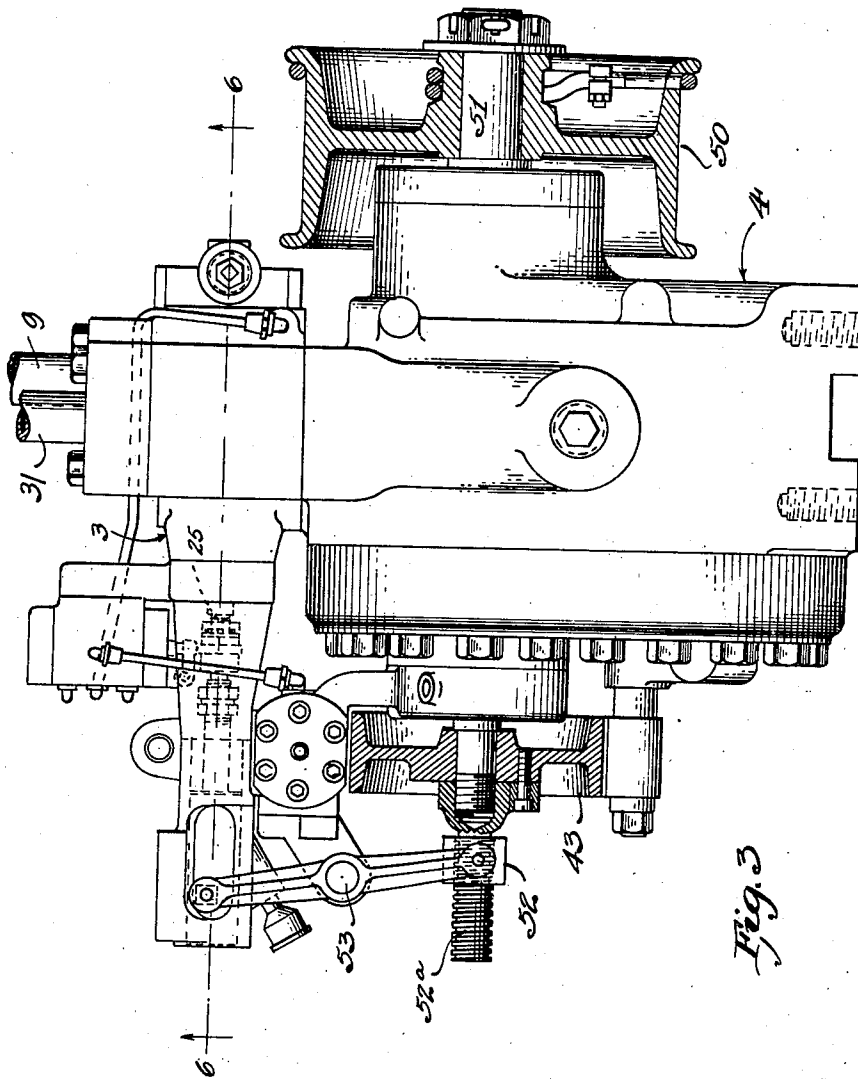


Fig. 3

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HYDRAULIC HOISTING UNIT AND CONTROL SYSTEM THEREFOR

Original Filed Sept. 22, 1933 7 Sheets-Sheet 4

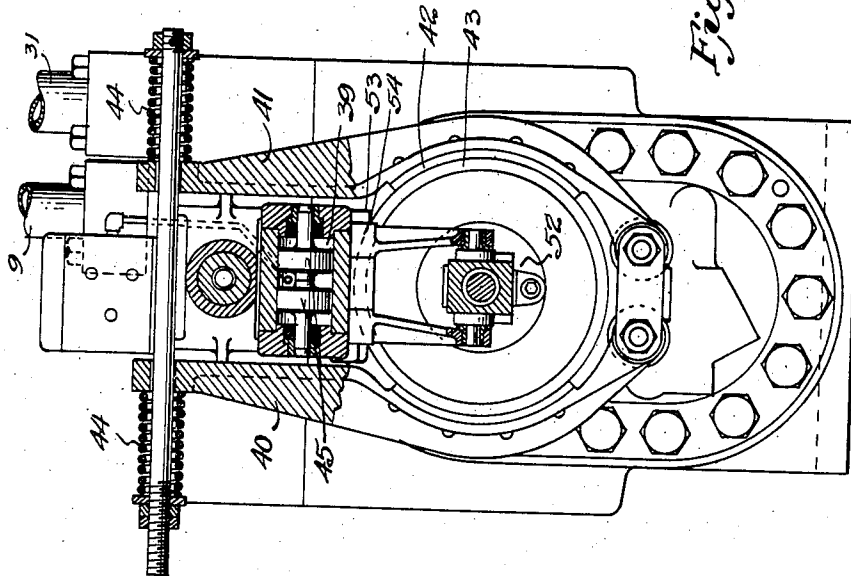


Fig. 5

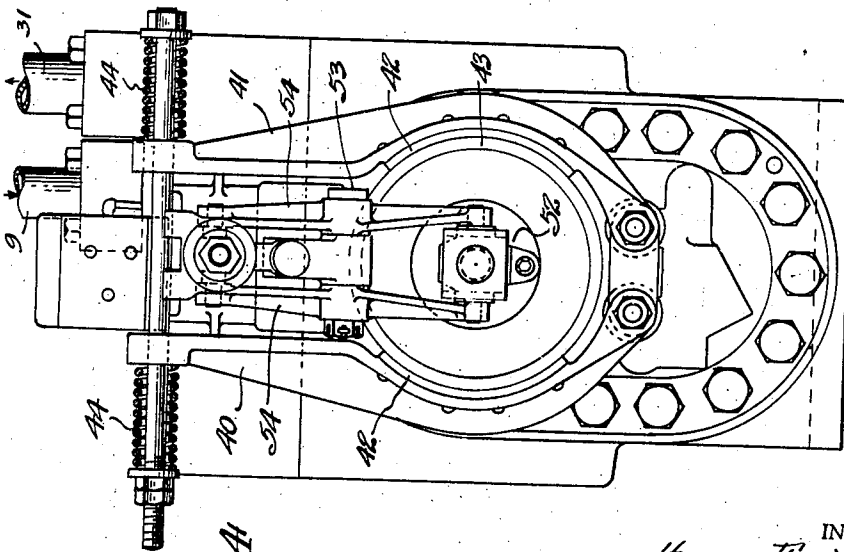


Fig. 4

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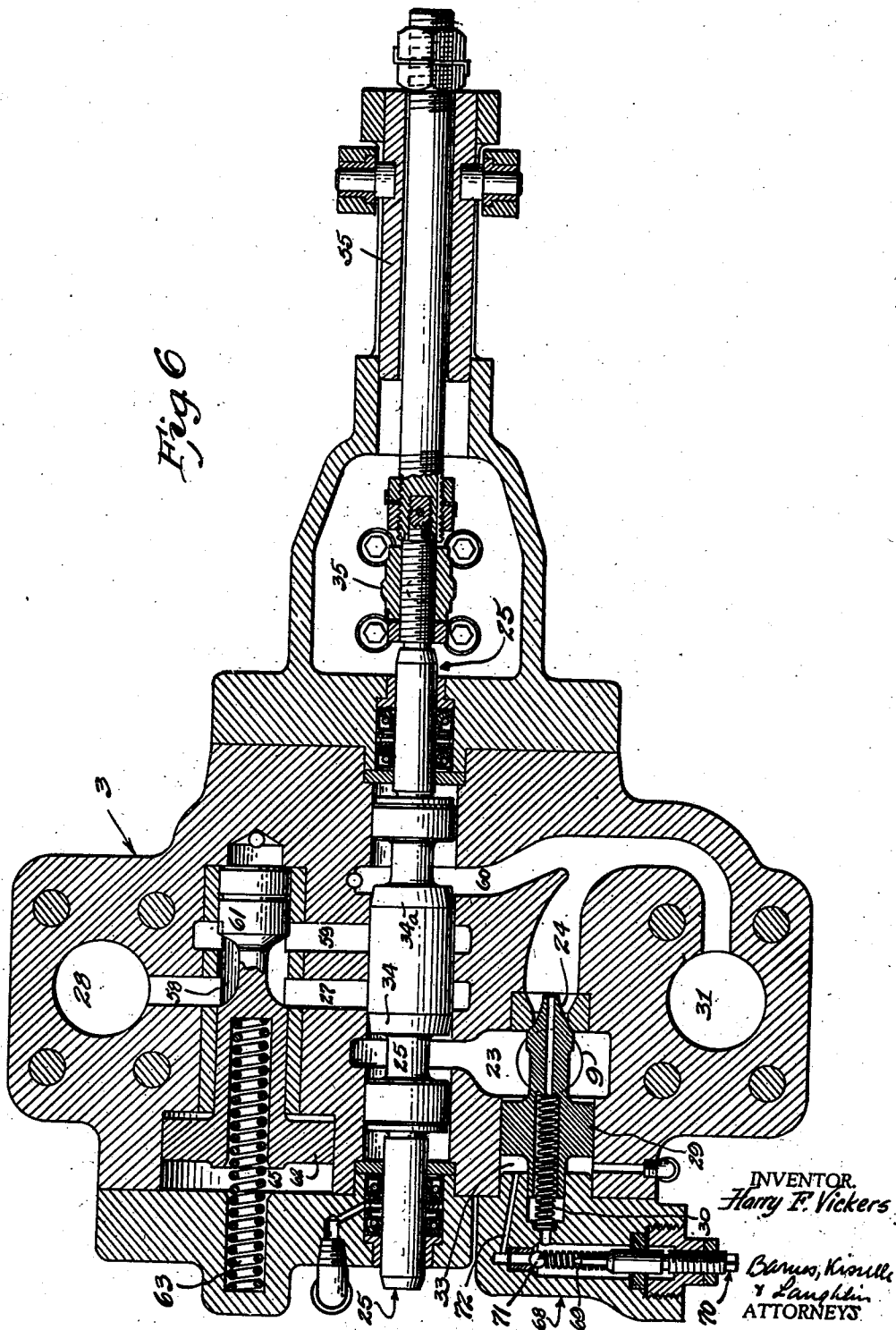
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HYDRAULIC HOISTING UNIT AND CONTROL SYSTEM THEREFOR

Original Filed Sept. 22, 1933 7 Sheets-Sheet 5



Jan. 11, 1938.

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HYDRAULIC HOISTING UNIT AND CONTROL SYSTEM THEREFOR

Original Filed Sept. 22, 1933

7 Sheets-Sheet 6

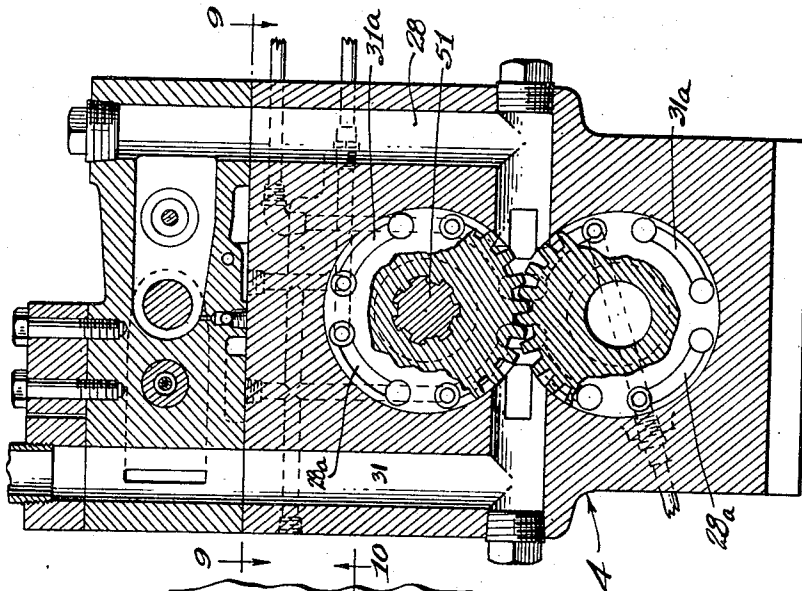


Fig. 8

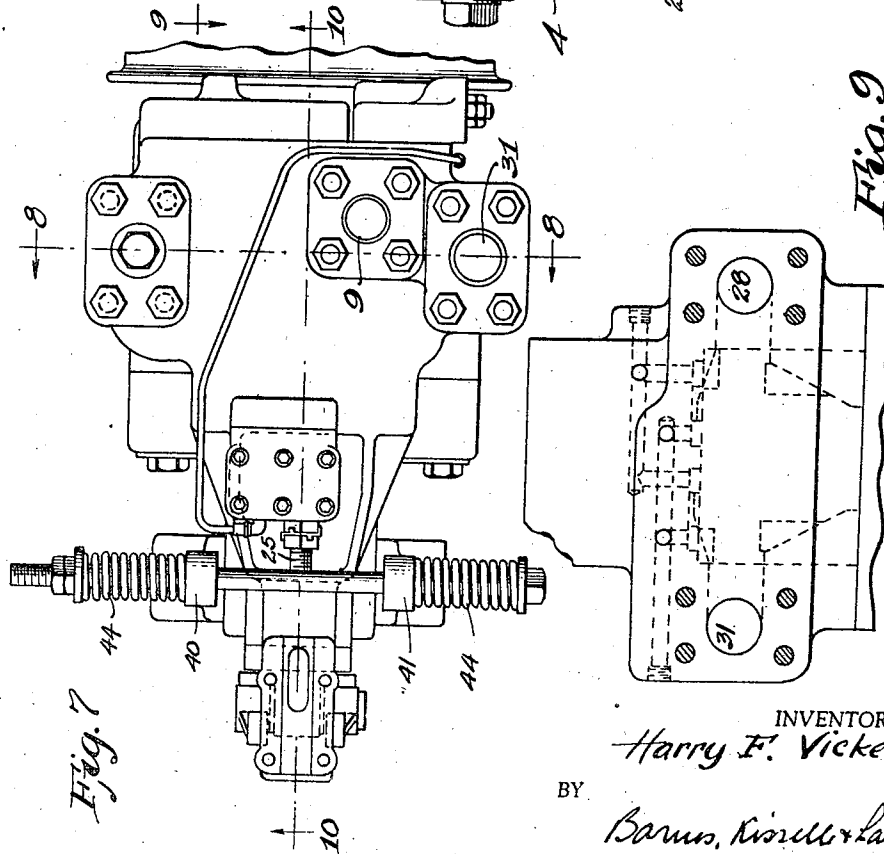


Fig. 9

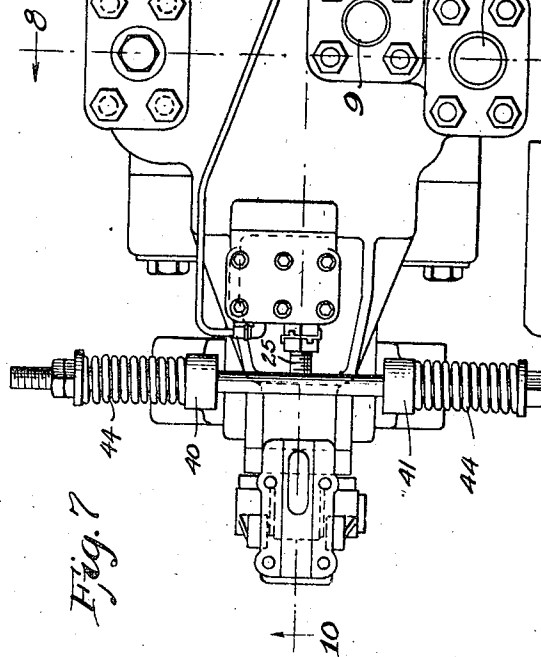


Fig. 7

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HYDRAULIC HOISTING UNIT AND CONTROL SYSTEM THEREFOR

Original Filed Sept. 22, 1933 7 Sheets-Sheet 7

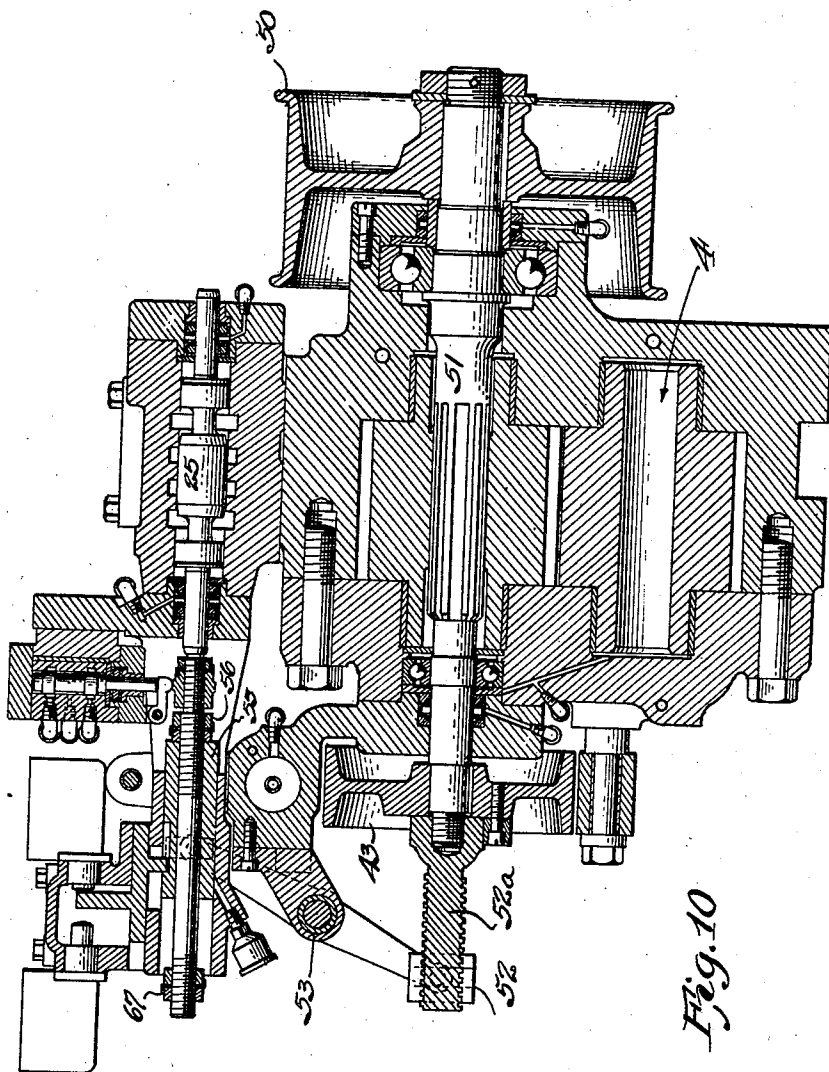


Fig. 10

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UNITED STATES PATENT OFFICE

2,104,780

HYDRAULIC HOISTING UNIT AND CONTROL
SYSTEM THEREFOR

Harry F. Vickers, Detroit, Mich.

Application September 22, 1933, Serial No. 690,630
Renewed April 1, 1937

12 Claims. (Cl. 254-163)

This invention relates to a hydraulic hoisting unit and control system therefor, and has to do particularly with improved hoisting and lowering means in combination with positive and extreme-
 5 ly safe controls together with improved accelerating and decelerating means relative to starting and stopping positions.

One of the important features of my invention has to do with a novel directional control valve and associated structure, so designed in combination with the valve seat as to provide a definite rate of flow and a resulting fixed speed rate of hoisting or lowering. An important element
 10 of this feature resides in the fact that the taper on the valve determines the volume flow and in combination with associated structure determines a fixed rate of movement, and a lowering speed rate regardless of load.

Another feature of the invention has to do with an automatic volume control working in combination with the directional control to assist in providing for a definite pressure drop through the orifice formed by the directional control member, said automatic volume control also serving
 25 as a maximum pressure control whereby to provide maximum acceleration during the hoisting stroke.

A further feature of the present invention has to do with a mechanical safety feature in the
 30 form of brakes operating in combination with the control mechanism whereby to insure positive locking at the proper time and to prevent power release before the brake is set, and without any appreciable wearing of the braking surface material.

A still further feature has to do with a combined pump unit operating in combination with the control unit and the hoist motor and including a small volume pump continuously operable
 40 to provide positive pressure for the control mechanism and a large volume pump operable only during the hoisting step, said two pumps being interconnected through a combined relief and balancing means, responsive to an increase in
 45 demand upon the large volume pump for allowing free flow from the small volume pump to the large volume pump line; resulting in the output of the small volume pump being delivered to do
 50 useful work along with the output of the large pump.

Other novel features including the means for relieving the large pump of operating pressure, except when hoisting, the circuit arrangement, and details of combination and arrangement will
 55

be more clearly set forth in the specification and claims.

In the drawings:

Fig. 1 is a flow sheet illustrating, somewhat slightly diagrammatic, the general combination
 5 of the various elements going to make up the complete circuit.

Fig. 2 is a vertical sectional view through the combined pump unit and particularly illustrating the combined relief and control valve.
 10

Fig. 3 is a side elevation of the hoist unit and control mechanism.
 15

Figs. 4 and 5 represent an end view and a partially cut away end view, respectively, of the hoist and control mechanism, and particularly
 20 showing the braking mechanism and control therefor.

Fig. 6 is a sectional view taken on line 6-6 of Fig. 3 and showing particularly the volume control and directional control units.
 25

Fig. 7 is a plan view of the structure shown in Figs. 3 to 5.

Fig. 8 is a sectional view taken on line 8-8 of Fig. 7.

Fig. 9 is a fragmentary plan view taken on line 9-9 of Fig. 8 and being directed particularly to the balanced gear housing of the hoist unit.

Fig. 10 is a vertical sectional view taken on line 10-10 of Fig. 7.

As best shown in Fig. 1, the hoisting unit and
 30 control system include a two section pump unit generally indicated as at 2, a control unit generally designated 3 including an auxiliary hand operated control unit 3a of the type shown in my copending application Serial No. 704,253, a
 35 motor and pump unit for the hoist generally designated 4, and a braking unit 5.

Referring particularly to the two section pump unit, as best illustrated in Fig. 2, this unit consists of a large volume pump unit generally designated 6 and located adjacent the shaft coupling
 40 7 which connects the pump unit with the initial source of power; and a small volume pump generally designated 8. Both pump sections are preferably positive displacement type pumps, the
 45 large pump supplying pressure through the line 9 for directly controlling the hoisting unit and the small section supplying pressure through the line 10 to control the brake and control valves (see Fig. 1).

As shown in Fig. 2, both pump sections 6 and 8 have a common inlet 11 and branch conduits 12 and 13, respectively. The liquid under pressure from section 6 passes through the outlet
 55 9a and, as will be later described, the large pump

6 is relieved of operating pressure except during the actual hoisting operation. This results in a considerable power saving, as otherwise the single large volume pump would have to operate at full pressure at all times. Oil also flows through the small pump unit 8 into the chamber 14, which chamber also surrounds a valve 15. The valve 15 is provided with a small piston 16, and the flow from the chamber 14 to the right hand side of the piston 16 is by means of a threaded resistance passage 75 formed between the parts 17 and 18, the chamber to the left of the piston 16 being vented through the conduit 19 to make the pressure in the chamber to the right of the piston, designated 20, effective.

As the pump 8 is continuously operated, the oil under pressure flows through the passageway and chamber 14 through the resistance passage and into the chamber 20, exerting thrust to the left which tends to overcome an adjustable tension spring 21. By overcoming the spring 21, the pressure in the chamber causes the valve 15 to move slightly to the left and take up a position whereby oil is bypassed into the chamber 22 which leads to the main operating passageway 9a, whereby oil is bypassed into the chamber 22 in just sufficient amount to maintain a balance between the pressure in the chamber 20 and the resistance of the spring 21, the oil being restricted in its flow from the chamber 14 to the chamber 20 a proper amount to tend to maintain this balance; or, in other words, this restriction is sufficient to prevent chattering and sudden movement of the valve. This condition results in valve 15 functioning as a relief valve during the time that the pressure in the chamber 22, and, of course, the main outlet passage 9a, is below the adjusted pressure of the spring 21, with the result that a predetermined pressure is maintained in passageway and chamber 14 at all times so as to definitely assure operating pressure for the control parts of the system.

When this control pressure which flows from the chamber 14 through the line 10 to the unit 3a (see Fig. 1) is utilized to operate the control unit to hoist, the pressure in the outlet 9a and chamber 22 rises, causing a back pressure against the overflow of liquid flowing from the chamber 14, tending to further overcome the spring 21 and open the valve 15 from its normal correct position. In the function of this circuit we may assume an adjusted operating pressure of five hundred pounds per square inch on the spring 21 and a final operating pressure of seven hundred pounds or more in the outlet 9a and the chamber 22. When the main pump line 9 is so restricted as to exceed this five hundred pounds pressure, such pressure is delivered into chamber 20, with the direct result that this considerably exceeds the adjusted tension of spring 21, causing the piston 16 on the valve 15 to move to its extreme operating distance to the left, whereby allowing free flow of oil from the chamber 14 to the chamber 22. This results in the output of the small pump 8 being delivered to do useful work along with the output of the large pump 6.

The result and operation of this circuit under the above assumed condition is that pressure would be maintained in the chamber 14 at a minimum of five hundred pounds per square inch, and pressure in the outlet 9a would vary from approximately zero to seven hundred or more pounds per square inch. It will thus be seen that this structure and circuit permit a large volume of liquid being supplied to operate the motor at

a relatively high operating pressure, and at predetermined intervals, and at the same time maintaining a somewhat lower operating pressure in the chamber 14 to assure a constant pressure supply in the line 10, which leads from the chamber 14, to the pilot or operating valve 3a and to the braking unit 5.

Referring particularly to the control unit 3, as best shown in Figs. 1 and 6, it will be seen that the large volume pump assisted by the small volume pump supplies pressure through the line 9 and into the chamber 23 of the main control valve unit 3. This chamber 23 surrounds an automatic volume control valve 24 and also extends to a position where it surrounds and communicates with a directional control valve 25. A conduit 26 connects the control valve 3a with the left hand side of the directional control valve 25 so that, by movement of the control valve 3a, pressure is admitted from the line 10 into the conduit 26 to shift the directional valve 25 to the right. This action permits oil to flow from the line 9, through chamber 23, into the chamber 27, which chamber is connected through to passage 28 which leads to the motor 4.

The valve 24 is provided with a piston valve having a piston portion 29 which is provided with ends or piston rods on each side of equal diameter. The piston 29 is normally urged to the right by a spring 30 of predetermined tension to normally prevent the flow of oil under pressure from the chamber 23 into the outlet passage 31 which leads to the return tank R. It will be seen that the valve 24 will remain on its seat as long as the pressure in the chamber 23, communicated through passageway 32 to a chamber 33 at the left hand side of the piston 29, plus the predetermined thrust of the spring 30, is sufficient to force all the pump output through the orifice, which is formed by the wall of the chamber 27 and the tapered portion 34 of the valve 25 when the valve 25 is moved to the right, as viewed in Figs. 1 and 6. It should be noted here that, as shown in dotted lines in Fig. 1, the passageway 32 is directly connected with the chamber 27; the extreme right hand of the passageway 32 being in communication with the exhaust chamber 60 when the valve 25 is moved to the left, as will be later explained. By way of example, it will be seen that if the spring 30 back of the piston 29 has a thrust equivalent to twenty pounds per square inch, such piston will maintain a closed position relative to the passage 31, until such time as the volume of liquid passing through the chamber 23 requires more than twenty pounds per square inch to force this volume of liquid through the clearance between the wall of the chamber 27 and the tapered portion 34 of the valve. It will thus be seen that the valve 24 will provide a definite pressure drop across an orifice of given size, resulting in a definite rate of flow through this orifice. It will thus be seen that the amount of taper 34 on the valve 25 becomes a method of fixing the speed rate of hoisting.

The valve 25 is provided with a cam 35 which normally contacts with a cam follower 36 when such valve 25 is in neutral position. Movement of the valve to the right, as above described, also moves the cam 35 to the right which in turn permits the follower 36 to be raised because of spring pressure behind a valve or plunger 37 formed in an auxiliary portion 3b of the control unit 3. Raising of this valve 37 permits pressure to flow from the line 10a into line 38, which

line 38 connects into a chamber 39 forming a part of the automatic brake structure. As best shown in Figs. 4 and 5, this brake structure consists of supported pivoted arms 40 and 41. These arms and the brake shoe portions 42 carried thereby are normally forced against the brake drum 43 because of springs 44 so that normally the arms 40 and 41 grasp and hold the brake drum mechanically. The cylinder 39 is positioned intermediate the arms 40 and 41 and carries oppositely acting pistons 45, with the result that substantially simultaneously with the raising of the valve 37, the pressure from the line 19a will be communicated through the line 38, into the cylinder 39 urging the pistons 45 outwardly to contact with and release the brake shoes 42.

It is desirable during non-hoisting operation to allow the pump oil to flow from the chamber 23 through the exhaust passage 31 back to the return tank or reservoir R. This is accomplished by normally venting the passage 33, which is at the rear of the piston 29 to the atmosphere, so that any pressure in the chamber 23 exceeding the resistance of the spring 30 will cause the valve 24 to move to the left. A valve 37a being normally downwardly spring pressed, will, when the plunger 37 is forced downwardly, due to the directional valve 25 returning to neutral position, connect the chamber 33 with the atmosphere or, more specifically speaking, the return line, by means of the conduit 46, conduit 46a connecting the cylinders of 37a and 37, and conduit 46b connecting the cylinder of 37 with the relief or drain conduit 48.

During the hoisting operation, the brake shoes being released by the application of pressure to the line 38, it will be seen that this movement also supplies pressure to the bottom of the valve 37a, overcoming the spring and moving this valve 37a upwardly and thus closing the exhaust vent so that during this period the chamber 33 is open to the effective pressure from the line 32. It will be seen that this construction and circuit are effective to positively relieve the large pump 8 from operating pressure except when hoisting. The hoisting unit 4, as shown in Fig. 1, and better illustrated in Figs. 7 to 10, embodies a balanced gear motor of the general construction described in my copending application Serial No. 557,862, filed August 18, 1931, teeth subjected to pressure in the pressure chamber at one side of the motor being balanced by pressure chambers 28a and the teeth on the other side, namely those on the exhaust side being relieved by balancing chambers 31a.

When the valve 24 is closed and the valve 25 moved to the right to permit the flow of liquid under pressure into the conduit 28, the hoisting motor, generally designated 4, is actuated to rotate the shaft 51 and the drum 50. As best shown in Figs. 1, 3 and 10, the other end of this shaft 51 carries a brake member 43 and also a traveling nut 52, connected with arms 54 pivoted as at 53 to transmit motion to a sliding sleeve 55. This sleeve 55 surrounds an extension of the valve 25. A threaded portion 52a which operates the traveling nut 52 is provided with threads of such pitch, proportioned in accordance with the leverage of the arms 54 and the hoisting distance or height so that when the member being hoisted approaches the extreme limit of such hoisting distance, the sliding sleeve 55 contacts with adjustable nuts 56 so that during the last portion of the movement, the sliding sleeve 55 will move the valve 25 towards

central or neutral position to gradually stop the flow of liquid to the chamber 27 from the chamber 23. This same movement depresses the plunger 37 and permits the valve 37a to lower to exhaust the chamber 33 to permit movement of the piston 29 to the left. Thus stopping movement of the motor 4 and also simultaneously cutting off the pressure from the line 19a and evacuating the chamber 39, allow the brake springs to apply brake pressure and hold the hoist at the place where it has just stopped, due to movement of the directional control valve 25. The tendency to hoist by the motor 4 is not completely removed until after the brakes are applied; this is accomplished by using a spring backed valve 37a of less strength than the back pressure built up by the sudden exhausting of oil from the cylinder 39 by the springs 44.

Movement of the control valve 3a in the opposite direction effects lowering of the elevator or hoist unit in that pressure from the small pump 3 is conducted through the line 57 to the chamber at the right of the valve 25 (see Fig. 1) to shift the valve to the left. This movement relieves the pressure in line 26 and also results in applying of pressure to the line 38 to operate the pistons 45 and to relieve the brake shoes as previously described.

During this lowering action, the motor 4 will operate as a pump and, referring to Figs. 1 and 6, it will be seen that oil in the passage 28 will flow through a chamber 58 to a passageway 59 and due to the position of the valve 25, when moved to the left, will pass into passageway 60 connected to the reservoir. The connection between the chambers 58 and 59 is controlled by a valve 61 formed integrally with a piston 62. This valve 61 is normally urged to the right, as viewed in Fig. 6, by a spring 63 of predetermined tension. As best shown in Fig. 1, chambers 64 and 65 are connected to passageway 59 by means of conduit 64a, thus permitting any pressure in passageway 59 to tend to overcome the tension of the spring 63, and in turn causing the valve 61 to restrict the passage of oil from the chamber 58 to the passageway 59.

An unrestricted passageway 66 directly connects the chambers 60 and 65a (as shown in dotted lines in Fig. 1), thus permitting the pressure in passageway or chamber 60 to aid the spring 63 in resisting the effect of pressure in the passageway 59. In operation, during the lowering of the hoist, the piston 62 and valve 61 will take up a position wherein the difference in pressure existing in chamber 59 and chamber 60 will be equivalent to the resistance of the spring 63 against fluid pressure in chambers 64 and 65.

A tapered surface 34a at the opposite end of the valve from the tapered surface 34 will, when the valve 25 moves to the left, act as an orifice between the chambers 59 and 60. Therefore, it will be seen that the balancing of the piston 62 and valve 61 determines a pressure drop across the orifice formed by the degree of taper between the surface 34a and the wall of chamber 59 resulting in a fixed flow rate which in turn results in a fixed descending rate for the elevator or hoist, all accomplished by controlling the exhaust from the motor 4 and through the chamber 28.

It will thus be seen that different rates of hoisting and/or lowering can be obtained by the simple step of placing a new valve member 25 in the control unit having a taper 34 and 34a

predetermined in accordance with the particular hoist for which it is to be used; it being understood, of course, that the degree of taper on 34 and 34a may be different, dependent upon the relative rate of hoisting, lowering, and deceleration desired in the particular job.

Descent of the hoist or elevator continues until the traveling nut 52, moving in the opposite direction, actuates the sleeve 55 until contact is made with the adjusting nuts 67 and thus moving valve 25 toward neutral position, and gradually decelerating and then stopping the descent of the hoist or elevator. Cam 35 again lowers the plunger 37 to exhaust cylinder 39 allowing the brakes to be applied to hold the hoist in its stopped position.

The conduit 32, see Fig. 1, has a double function in that it not only acts in assisting to maintain a constant head across the orifice formed by the surface 34 during hoisting, but also functions in combination with the valve 68 to provide a maximum pressure control of the pump supply during hoisting, thereby providing maximum acceleration and control during the hoisting stroke. Referring more particularly to Fig. 6, the valve 68 includes a spring 69, the strength of which may be relatively adjusted by the mechanism 70 so that the spring 69 holds the valve member 71 on its seat until the pressure in the chamber 33 exceeds the resistance of the valve 71 and spring 69. If the pressure in chamber 33 should develop sufficiently to unseat the valve 71, liquid will pass by said valve and through the drilled hole in the valve member 24, with the result that the valve 24 and piston 29 will rapidly unseat to bypass the surplus oil to the tank, the valve 24 and piston 29 in this connection acting as a relief valve similar to the relief valve disclosed in my application Serial No. 552,692, filed July 23, 1931, inasmuch as the passageway 32 is smaller than the passageway 72 leading from the chamber 33 to the valve 71. It is therefore obvious that the valve 24 acts as a non-chattering relief valve and that any increase in pressure in the chamber 23 beyond the maximum pressure seating of the valve 71, which controls the pressure in the chamber 33, will cause the valve 24 to unseat, allowing excess oil to pass from the chamber 23 to chamber 31 and to the return tank. Thus this valve acts both as a means for maintaining constant head across the fixed orifice and also as a relief valve for controlling maximum pressure.

When the valve 25 moves to the left, the tapered portion 34a will uncover the extreme right hand end of passageway 32 and open same to the exhaust conduit 60, unseating the valve 24.

Attention is called to the important point that the combined relief and unloading valve permits the small volume pump to operate at the same pressure as the large volume pump, otherwise it would operate at a higher pressure during hoisting.

It will be seen that the degree of taper 34 and 34a on the valve 25 will provide deceleration at any rate desired, and in all cases will effect a smooth stop. The unloading valve 37a in combination with valve 37 effects release of the main pump only after pressure from brake mechanism has been released, to prevent power release before the mechanical brake is set.

What I claim is:

1. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, orifices

through which liquid flows to and from said unit, and means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during hoisting or lowering.

2. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, orifices through which liquid flows to and from said unit, means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during hoisting or lowering, normally applied mechanical brakes for said hoist, and means responsive to movement of said directional control means for hydraulically releasing said brakes.

3. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, orifices through which liquid flows to and from said unit, means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during hoisting or lowering, normally applied mechanical brakes for said hoist, means responsive to movement of said directional control means for hydraulically releasing said brakes, and means responsive to the movement of said control means to neutral flow stopping position for allowing positive application of the mechanical brakes.

4. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, orifices through which liquid flows to and from said unit, and means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during hoisting or lowering, said source of supply including a main supply pump and a control supply pump and a combined relief and control valve normally maintaining control pressure throughout the system and admitting liquid from the control pump into the main pump when pressure in the main pump line exceeds the control pressure maintained by said valve.

5. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, portions of said means forming orifices through which liquid flows to and from said unit, and means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during hoisting or lowering.

6. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, orifices through which liquid flows to and from said unit, and means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during hoisting or lowering, one of said last named means also serving to control the maximum pressure supply.

7. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, portions of said means forming orifices through which liquid flows to and from said unit, and means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during

hoisting or lowering, one of said last named means also serving as an automatic volume control.

8. A hydraulic hoist system comprising a source of pressure supply, a motor-pump unit for said hoist, directional control means, orifices through which liquid flows to and from said unit, means responsive to the position of said control means for effecting a predetermined pressure drop across said orifices whereby to control the rate of movement during hoisting or lowering, normally applied mechanical brakes for said hoist, means responsive to movement of said directional control means for hydraulically releasing said brakes, said source of supply including a main supply pump and a control supply pump, and a combined relief and control valve normally maintaining control pressure throughout the control system and maintaining said control pressure while admitting liquid from the control pump into the main pump when pressure in the main pump line exceeds the control pressure maintained by said valve.

9. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to stop the flow of liquid and stop the hoist, and means responsive to said movement of said directional control means for effecting application of said brakes to hold the hoist in its arrested position and a flow control cooperating with said control means when moved in one direction to receive fluid pressure from said unit operating as a pump to control the rate of lowering of the hoist.

10. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, combined mechanical and hydraulic brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to stop the flow of liquid and stop the hoist, means responsive to said movement of said directional control means for releasing said hydraulic and applying said mechanical brake structure to hold the hoist in its arrested position, and means for retarding said release and application.

11. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to stop the flow of liquid and stop the hoist, means responsive to said movement of said directional control means for effecting application of said brakes to hold the hoist in its arrested position, means for moving said directional control valve in either direction from said neutral position to effect raising or lowering of the hoist, said directional control valve cooperating with pressure chambers to form fixed orifices in each of said positions, and means for maintaining a predetermined differential across said orifices in either of said positions.

12. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to control the flow of liquid and reduce the speed of the hoist at a predetermined rate to accomplish a smooth stop, means responsive to said move-

ment of said directional control means for effecting application of said brakes to hold the hoist in its arrested position, means for moving said directional control valve in either direction from said neutral position to effect raising or lowering of the hoist, said directional control valve cooperating with pressure chambers to form fixed orifices in each of said positions, and means for maintaining a predetermined differential across said orifices in either of said positions, one of said means for predetermining the differential across one of said orifices including means for controlling the maximum pressure in said source of pressure supply.

13. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to stop the flow of liquid and stop the hoist, and means responsive to said movement of said direction control means for effecting application of said brakes to hold the hoist in its arrested position, said pressure supply including a large volume actuating pump and a small volume control pump.

14. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to stop the flow of liquid and stop the hoist, means responsive to said movement of said directional control means for effecting application of said brakes to hold the hoist in its arrested position, means for moving said directional control valve in either direction from said neutral position to effect raising or lowering of the hoist, said directional control valve cooperating with pressure chambers to form fixed orifices in each of said positions, and means for maintaining a predetermined differential across said orifices in either of said positions, said pressure supply including a large volume actuating pump and a small volume control pump.

15. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to stop the flow of liquid and stop the hoist, means responsive to said movement of said directional control means for effecting application of said brakes to hold the hoist in its arrested position, means for moving said directional control valve in either direction from said neutral position to effect raising or lowering of the hoist, said directional control valve cooperating with pressure chambers to form fixed orifices in each of said positions, and means for maintaining a predetermined differential across said orifice in either of said positions to control the speed of raising and lowering, one of said means for predetermining the differential across one of said orifices including means for controlling the maximum pressure in said source of pressure supply, said pressure supply including a large volume actuating pump and a small volume control pump.

16. A hydraulic hoist system, comprising a source of pressure supply, a motor-pump unit for said hoist, brake structure for said hoist, directional control means, means actuated by the position of the hoist for moving said direc-

tional control means towards neutral position to control the flow of liquid and reduce the speed of the hoist at a predetermined rate to accomplish a smooth stop, means responsive to said movement of said directional control means for effecting application of said brakes to hold the hoist in its arrested position, means for moving said directional control means in either direction from said neutral position, and a flow control cooperating with said control means when moved in one direction to receive fluid pressure from said unit operating as a pump to control the rate of lowering of the hoist.

17. A hydraulic hoist system, comprising a source of pressure supply, a hydraulic power unit directly connected to the hoist for operating same, mechanical means for locking said power unit and hoist in hoisted position, directional control means, means actuated by the position of the hoist for moving said directional control means towards neutral position to control the flow of liquid and reduce the speed of the hoist at a

predetermined rate to accomplish a smooth stop, means responsive to said movement of said directional control means for effecting application of said mechanical means to hold the hoist in its arrested position, and means for hydraulically moving said directional control means in either direction from said neutral position to effect raising or lowering of the hoist.

18. A hydraulic hoist system, comprising a source of pressure supply, a hydraulic power unit directly connected to the hoist for operating same, mechanical means for locking the power unit in hoisted position, and means hydraulically connected to said source of pressure supply and said power unit and actuated by the movement of the movable element of said power unit towards hoisted position and operating in combination with said mechanical locking means to insure a positive locking of the power unit and the hoist before the release of hoisting pressure from said source of supply and in said system.

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