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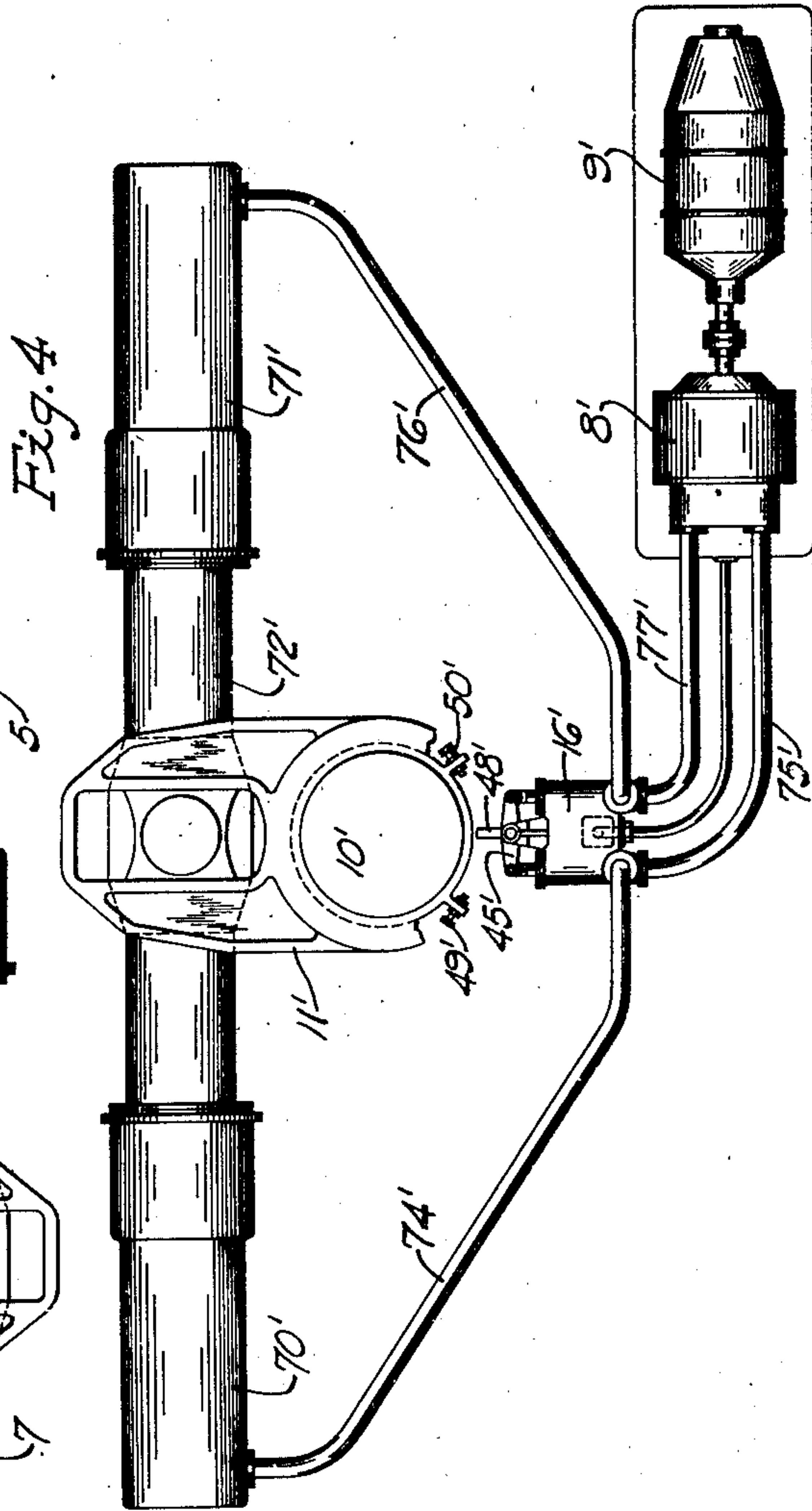
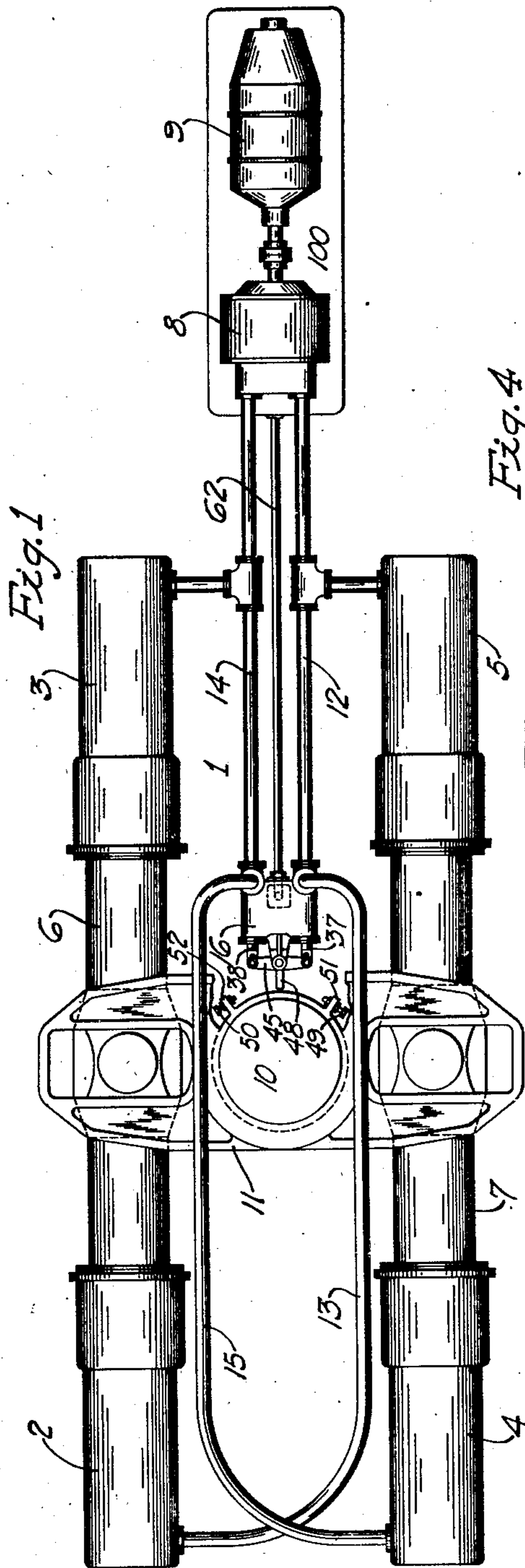
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2,125,452

HYDRAULIC MOTOR

Filed March 10, 1934

2 Sheets-Sheet 1



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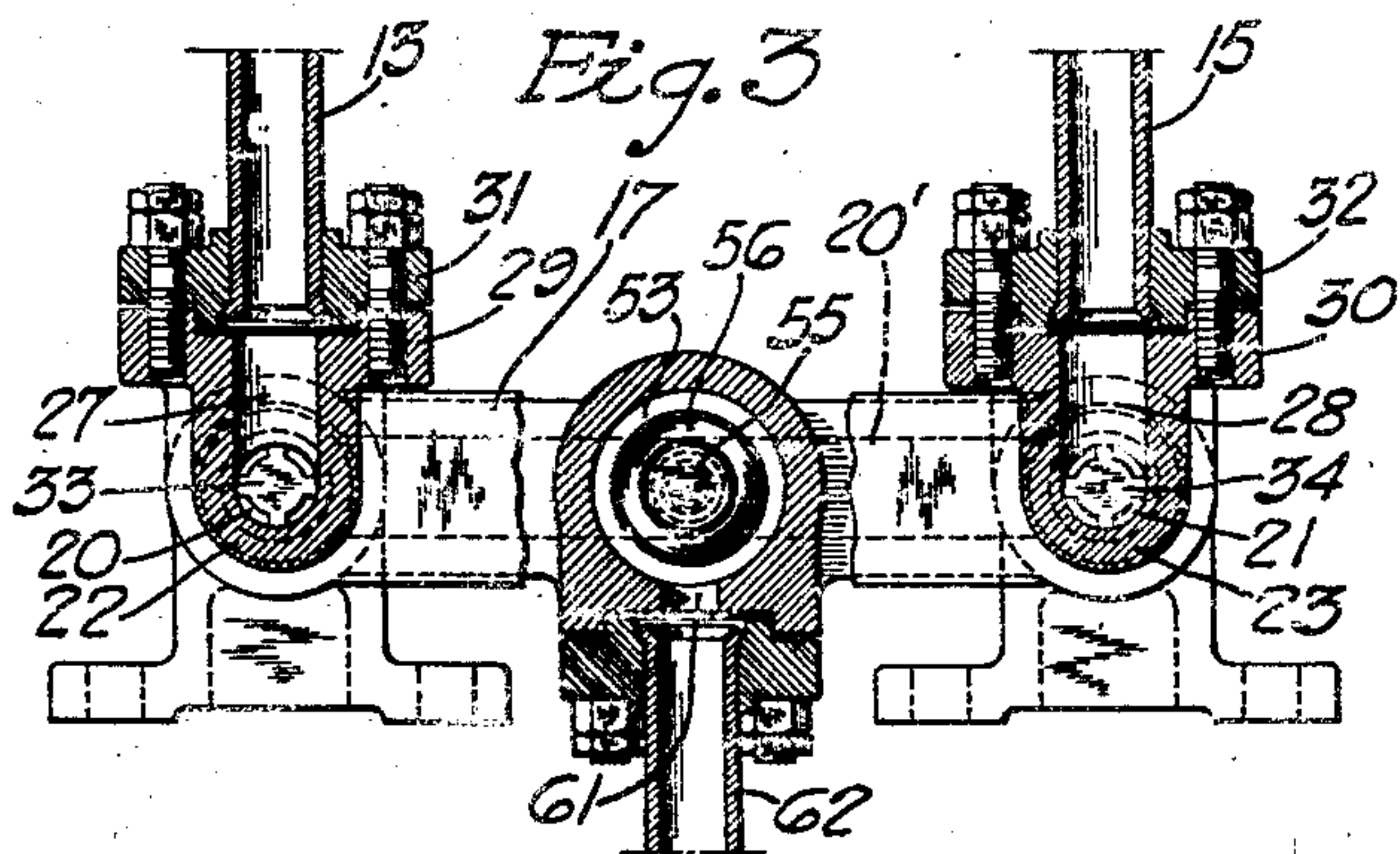
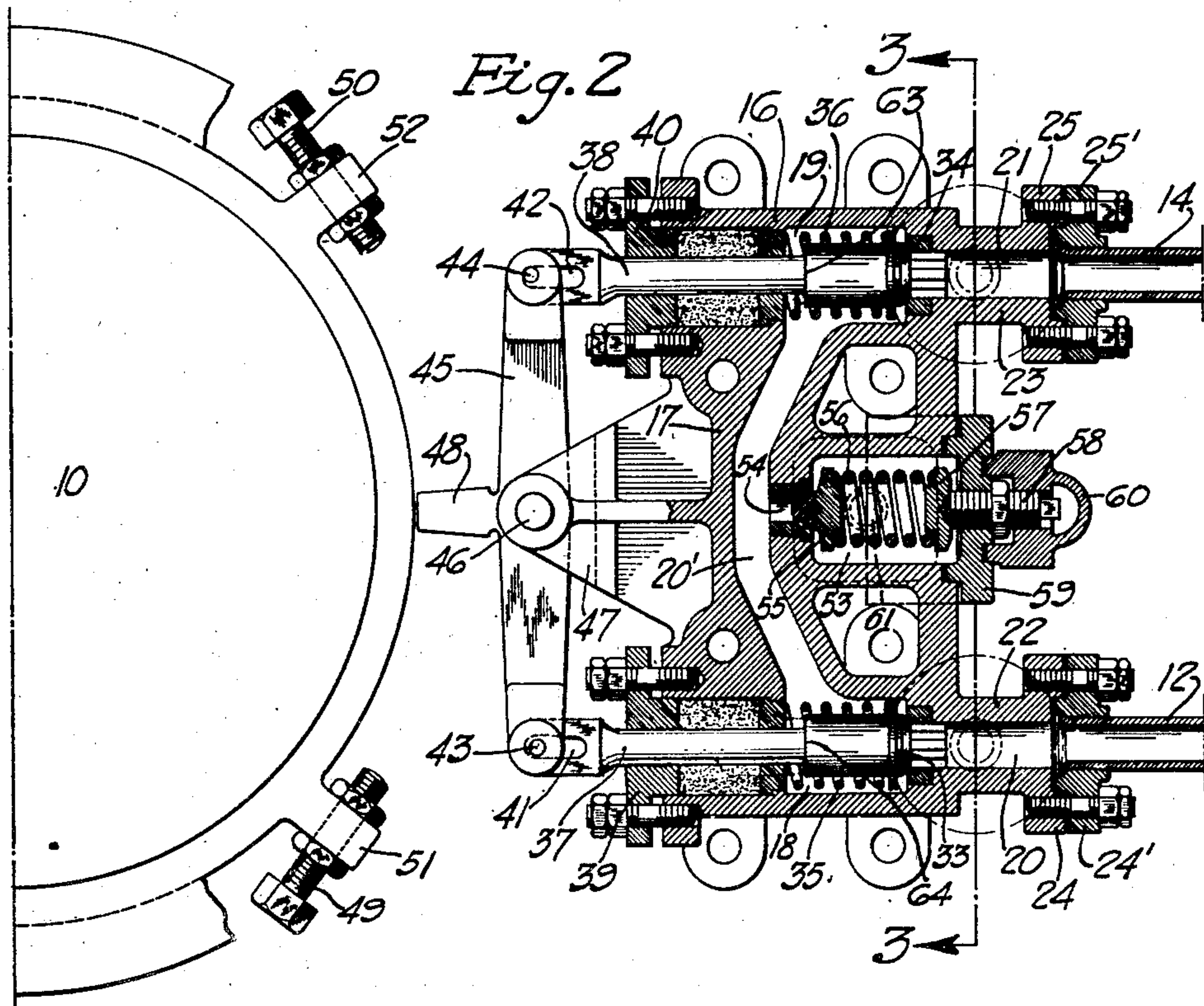
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UNITED STATES PATENT OFFICE

2,125,452

HYDRAULIC MOTOR

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14 Claims. (Cl. 60—52)

This invention relates to hydraulic motors, and more particularly to hydraulic motors of the reciprocating plunger type adapted for use in steering mechanisms.

One object of the present invention is to provide a generally improved valve mechanism for fluid motors of the stated character which functions to bypass fluid from the pressure side of the motor to the exhaust side thereof when the ram approaches its limit of travel in either direction.

Another object is to provide a fluid motor of the stated character having associated therewith a valve unit enclosed within a suitable casing and operatively connected to a driven member, and so constituted as to bypass fluid from the pressure side of the motor to the exhaust side thereof when the latter approaches its limit of travel in either direction, and to prevent a reverse flow of fluid when the pressure at both sides of the motor becomes substantially balanced.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a plan view of the assembled construction including the valve unit comprising the present invention.

Fig. 2 is a plan view partly in section of the valve unit and the operating mechanism therefor.

Fig. 3 is a sectional elevational view taken substantially along line 3—3 of Fig. 2.

Fig. 4 is a plan view showing the valve unit applied to a fluid motor of the single ram type.

Referring to the drawings, the numeral 1 designates generally a fluid motor comprising aligned pairs of cylinders 2, 3 and 4, 5 having rams 6 and 7, respectively, operating therein. Motor 1 is actuated by a variable stroke reversible discharge pump 8 driven by any suitable power means, such, for example, as an electric motor 9. Pump 8 is of the general type shown and described in the United States patent to Hele-Shaw No. 1,077,979, to which reference may be had for a full disclosure thereof. Rams 6 and 7 are operatively connected to a rudder stock 10 by means of a crosshead 11. One side of pump 8 is operatively connected to cylinders 2 and 5 of motor 1 through pipe connections 12 and 13, while the other side of said pump is connected to cylinders 3 and 4 by pipes 14 and 15. Pipes 12 and 13 are connected to one side of a valve unit 16, while pipes 14 and 15 are connected to the other side thereof, as shown in Fig. 1. Valve unit 16 comprises a casing 17

having valve chambers 18 and 19 provided at the opposite ends thereof, connected by a communicating passage 20'. Communicating with chambers 18 and 19 are a pair of passages 20 and 21 provided in extensions 22 and 23 respectively, of casing 17. The outer ends of extensions 22 and 23 are provided with flanges 24 and 25 to which are bolted companion flanges 24' and 25' which secure pipes 12 and 14, respectively, to casing 17.

Referring to Fig. 3, extensions 22 and 23 are provided with vertical passages 27 and 28 respectively, extending upwardly from passages 20 and 21. The upper ends of extensions 22 and 23 terminate in flanges 29 and 30 to which are bolted companion flanges 31 and 32 which secure pipes 13 and 15 respectively to casing 17.

A pair of valves 33 and 34 engage valve seats provided at the inner ends of passages 20 and 21, respectively, and are normally held in seated position by springs 35 and 36. The stems 37 and 38 of valves 33 and 34 extend through glands 39 and 40 respectively, and the outer ends of which are provided with slots 41 and 42 which respectively receive pins 43 and 44 provided at the opposite ends of a lever 45. Lever 45 is pivoted intermediate its ends at 46 to an extension 47 of casing 17. A projection 48 extends outwardly from lever 45 and is adapted to be engaged by bolts 49 and 50 adjustably mounted in a pair of ears 51 and 52, respectively, projecting outwardly at spaced points from rudder stock 10. Bolts 49 and 50 are so positioned that when the rudder stock 10 has been operated a predetermined amount in one direction bolt 49 will engage projection 48 to open valve 33 and when operated a predetermined distance in the reverse direction bolt 50 will engage projection 48 to open valve 34. As shown in Fig. 2, the diameters of pins 43 and 44 are slightly less than the width of slots 41 and 42 to enable tilting of lever 45 about its pivot 46.

As shown in Fig. 2, casing 17 of valve unit 16 is provided with an intermediate chamber 53, and a passage 54 establishes communication between said chamber and communicating passage 20'. A relief valve 55 normally engages a valve seat provided at the inner end of passage 54 and thereby normally prevents the passage of fluid from passage 20' to chamber 53. Valve 55 is normally held in closed position by a coil spring 56 which extends between the latter and an adjustable spring seat 57. An adjustable bolt 58 extends through a cover plate 59 for chamber 53, and engages spring seat 57. A cap 60 is provided to house the outer end of bolt 58. By

this construction it is seen that the tension of spring 56 may be regulated by simply adjusting bolt 58. Fluid entering chamber 53 is discharged into a makeup tank 100 for the system through an aperture 61 provided at the bottom of said chamber and a pipe 62.

From this construction it is seen that if pump 8 is so adjusted as to deliver fluid pressure to pipe 12, and suction to pipe 14, the pressure of this fluid acting against the inner end of valve 33 will actuate the same to the left (Fig. 2) against the tension of spring 35. Fluid may then pass through communicating passage 20' and into chamber 19. This pressure then acts against the annular shoulder 63 provided on valve 34, thereby tending to retain the same upon its seat. It is also seen that if pump 8 is adjusted so as to deliver fluid pressure to pipe 14, valve 34 will be actuated to the left against the tension of spring 36, thereby permitting fluid to enter chamber 18 through communicating passage 20'. The pressure acting against the annular shoulder 64 provided on valve 33 retains the latter upon its seat. It is also seen that during operation of the device, in the event that the pressure in passage 20' should exceed the tension of spring 56, valve 55 will be moved to the right (Fig. 2), thereby permitting fluid to flow from passage 20' into chamber 53 and thence to exhaust through pipe 62. By this construction excessive pressures in the system are prevented.

Referring to Figs. 1 and 2, it will be observed that when pump 8 has been adjusted to deliver fluid pressure to pipe 12, fluid under pressure will enter cylinders 2 and 5 thereby causing rams 6 and 7 to operate crosshead 11 and rudder stock 10 in a clockwise direction. As the rams and rudder stock approach the limit of their travel the inner end of bolt 50 will engage projection 48 on lever 45, thereby actuating valve 34 to the left against the tension of spring 36, and also against the pressure of the fluid acting on shoulder 63, thus establishing communication between pipes 12 and 14. Fluid under pressure then also enters cylinders 3 and 4 with the result that the pressure on both sides of the motor soon becomes balanced or equalized, thereby effecting a cushioning action on the rams and stoppage thereof from further travel. At this time pump 8 has been adjusted to neutral position. Mechanisms for adjusting pumps in this manner are well known in the art, and for a full disclosure of such a mechanism, reference may be had to my United States Patent No. 1,986,640. Spring 35 will now urge valve 33 into engagement with its seal and thereby prevent a reverse flow of fluid in the system. Now upon reversal of the discharge of pump 8 fluid under pressure will enter cylinders 3 and 4 causing rams 6 and 7 to operate crosshead 11 and rudder stock 10 in a counter clockwise direction. This movement continues until the inner end of bolt 49 engages projection 48 thereby causing valve 33 to move to the left, and thus permit fluid from pipe 14 to flow to pipe 12, and thence to cylinders 2 and 5, thereby effecting a cushioning action on the rams and stoppage thereof from further travel. At this time pump 8 has again been adjusted to neutral position, as above described, and when the pressure in the system again is balanced spring 36 will urge valve 34 upon its seat, and thereby prevent a reverse flow of fluid in the system. Valves 33 and 34 may be urged to closed position in the manner described above owing to the lost motion

provided by virtue of the pin and slot connection between said valves and lever 45.

The bolts 49 and 50 are so adjusted as to insure unseating of valves 34 and 33 respectively, when rams 6 and 7 and rudder stock 10 approach their limit of travel.

In the construction shown in Fig. 4 a single pair of cylinders 70' and 71', having a ram 72' operating therein, are operatively connected to a pump 8' through pipes 74', 75' and 76', 77', respectively. Ram 72' is operatively connected to rudder stock 10' through a crosshead 11'. A valve unit 16', similar to valve unit 16 shown in Figs. 2 and 3, is connected to pipes 74', 75' and 76', 77' and a pair of adjustable bolts 49' and 50' provided in rudder stock 10' are adapted to engage projection 48' provided on a lever 45', associated with said valve unit when the said rudder stock is actuated toward its limiting positions by ram 72'. By this construction it is apparent that when ram 72' is actuated in either direction, upon approaching its limit of travel, bolt 49' or 50' will actuate the valves of unit 16' to effect bypassing of the fluid between the cylinders. This action obviously produces a cushioning effect upon the ram and prevents damage to the parts.

While the embodiments herein shown are admirably adapted to fulfill the objects primarily stated it is to be understood that the invention is not to be limited to the embodiments herein shown as it may be embodied in other forms, all coming within the scope of claims which follow.

What is claimed is:

1. In a device of the class described, the combination with a fluid motor, of a pump for actuating said motor, said motor comprising a pair of aligned cylinders and a ram operative in said cylinders, a rudder stock operatively connected to said ram, normally inoperative bypass means connecting said cylinders, and means provided on said rudder stock for actuating said by-pass means to render the latter operative when said rudder stock approaches its limit of travel in either direction.
2. In a device of the class described, the combination with a fluid motor, of a pump for actuating said motor, said motor comprising a pair of aligned cylinders, and a ram operative in said cylinders, a rudder stock operatively connected to said ram and adapted to be adjusted upon movement of said ram in either direction, by-pass means disposed between the cylinders of said motor, and means provided on said rudder stock for actuating said bypass means when the rudder stock approaches its limit of travel in either direction to thereby equalize the pressure in said cylinders.
3. In a device of the class described, the combination with a fluid motor, comprising a pair of aligned cylinders, and a ram operative in said cylinders, of a pump for actuating said motor, a rudder stock operatively connected to said ram, bypass means, piping connecting said bypass means with said cylinders, normally closed valves in said bypass means, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, operating means for said valves, and means provided on said rudder stock for actuating said operating

means to unseat the valve held in closed position when said rudder stock approaches its limit of travel to equalize the pressures in said cylinders.

4. In a device of the class described, the combination with a fluid motor, comprising a ram, a pair of cylinders embracing said ram, of a pump, piping connecting said pump to said cylinders whereby pressure may be applied to either of said cylinders while exhausting the other, bypass means connected to said piping having normally closed valves provided therein, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, of a rudder stock operatively connected to said ram, operating means mounted on said rudder stock, and means operated by said last mentioned means when the rudder stock approaches its limit of travel on one direction to open one of said valves held in closed position, and to open the other of said valves held in closed position when approaching its limit of travel in the reverse direction.

5. In a device of the class described, the combination with a fluid motor comprising a ram, and a pair of cylinders embracing the opposite ends of said ram, of means for applying fluid pressure to either of said cylinders while exhausting the other, a rudder stock operatively connected to said ram, bypass means between said cylinders comprising a casing, a pair of normally closed valves provided in said casing, a communicating passage between said valves, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, a relief valve connecting said communicating passage to exhaust, a common operating member for said first mentioned valves, means mounted on said rudder stock for actuating said operating member to open one of said valves held in closed position when the ram approaches its limit of travel in one direction, and additional means mounted on said rudder stock for actuating said operating member to open the other of said valves held in closed position when the ram approaches its limit of travel in the reverse direction.

6. In a device of the class described, the combination with a fluid motor, comprising a ram, and a pair of cylinders embracing the opposite ends of said ram, of a pump, piping connecting said pump with said cylinders whereby pressure may be applied to either of said cylinders while exhausting the other, bypass means connected to said piping, said bypass means comprising a casing, a pair of normally closed valves provided in said casing, a communicating passage between said valves whereby when either of said valves is unseated by fluid pressure from said pump said fluid pressure will tend to retain the other of said valves in closed position, a relief valve connecting said communicating passage to exhaust to prevent excessive pressures within said casing, and means for unseating the valve held in closed position by the pressure from said pump when the ram approaches its limit of travel to thereby equalize the pressure in said cylinders,

and means for normally holding said valves in closed position.

7. In a device of the class described, the combination of a fluid motor, comprising a ram, a pair of cylinders embracing the opposite ends of said ram, of a pump, piping connecting said pump with said cylinders whereby pressure may be applied to one of said cylinders while exhausting the other, a rudder stock operatively connected to said ram, bypass means connected to said piping, normally closed valves in said bypass means, one of said valves controlling the flow of fluid from the cylinder subjected to pressure to the cylinder connected to exhaust, when said ram is moved in one direction, the other of said valves controlling the flow of fluid from the cylinder subjected to pressure to the cylinder connected to exhaust when the ram is actuated in the reverse direction, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, a common operating member for said valves, means provided on said rudder stock for actuating said member to open one of said valves held in closed position when said rudder stock approaches its limit of travel in one direction, and additional means on said rudder stock for actuating said member to open the other of said valves held in closed position when said rudder stock approaches its limit of travel in the reverse direction.

8. In a device of the class described, the combination with a fluid motor, comprising a pair of rams, cylinders embracing the opposite ends of each of said rams, of means for applying fluid pressure to said cylinders, piping connecting the cylinders of one ram with the diagonally opposite cylinders of the other ram whereby pressure may be simultaneously applied by said means to either of said connected pairs of cylinders while exhausting the other, bypass means between said connected pairs of cylinders, normally closed valves in said bypass means, one of said valves controlling the flow of fluid from the cylinders subjected to pressure to the cylinders connected to exhaust when the rams are actuated in one direction, the other of said valves controlling the flow of fluid from the cylinder subjected to pressure to the cylinder connected to exhaust when the rams are actuated in the reverse direction, said valves being so disposed that when one of said connected pairs of cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said connected pairs of cylinders is subjected to pressure said last mentioned valve is opened and said first mentioned valve is held in closed position, a common operating member for said valves, a rudder stock operated by said rams, means provided on said rudder stock for actuating said member to open one of said valves held in closed position when said rudder stock approaches its limit of travel in one direction, and additional means on said rudder stock for actuating said member to open the other of said valves held in closed position when said rudder stock approaches its limit of travel in the reverse direction.

9. In a device of the class described, the combination of a fluid motor, comprising a ram, and a pair of cylinders embracing the opposite ends

of said ram, of means for applying fluid pressure to either of said cylinders while exhausting the other, bypass means between said cylinders comprising a casing, a pair of normally closed valves provided in said casing, a communicating passage between said valves, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, a relief valve connecting said communicating passage to exhaust, a common operating member for said first mentioned valves, adjustable means for actuating said operating member to open one of said valves held in closed position when the ram approaches its limit of travel in one direction, and a second adjustable means for actuating said operating member to open the other of said valves held in closed position when the ram approaches its limit of travel in the reverse direction, and resilient means for urging the valve opened by the application of fluid pressure to closed position when the pressure at both ends of said ram becomes substantially balanced.

10. In a device of the class described, the combination with a fluid motor, comprising a ram, a pair of cylinders embracing the opposite ends of said ram, of a pump, piping connecting said pump with said cylinders whereby pressure may be applied to either of said cylinders while exhausting the other, a rudder stock operatively connected to said ram, bypass means connected to said piping, normally closed valves in said bypass means, one of said valves controlling the flow of fluid from the cylinder subjected to pressure to the cylinder connected to exhaust when said ram is moved in one direction, the other of said valves controlling the flow of fluid to the cylinders subjected to pressure to the cylinder connected to exhaust when the ram is moved in the other direction, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, a common operating member for said valves, adjustable means provided on said rudder stock for actuating said member to open one of said valves held in closed position when said rudder stock approaches its limit of travel in one direction, and a second adjustable means on said rudder stock for actuating said member to open the other of said valves held in closed position when said ram approaches its limit of travel in the reverse direction.

11. In a device of the class described, the combination with a fluid motor comprising a ram, and a pair of cylinders embracing the opposite ends of said ram, of means for applying fluid pressure to either of said cylinders while exhausting the other, bypass means between said cylinders comprising a casing, a pair of normally closed valves provided in said casing, a communicating passage between said valves, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, a common operating member

for said valves, means for actuating said member to open the valve held in closed position when the ram approaches its limit of travel in one direction to thereby balance the pressures at each side of said motor, spring means for urging the valve held in open position by the application of fluid pressure to closed position when the pressure at each side of said motor becomes substantially balanced, and a second means for actuating said member to open the other of said valves held in closed position when the ram approaches its limit of travel in the reverse direction to again balance the pressures at each side of said motor, and resilient means for urging the other of said valves held in open position by the application of fluid pressure to closed position when the pressure at both sides of said motor again becomes substantially balanced.

12. In a device of the class described, the combination with a fluid motor comprising a pair of rams, and cylinders embracing the opposite ends of each of said rams, of means for applying fluid pressure to said cylinders, piping connecting the cylinders of one ram with the diagonally opposite cylinders of the other ram whereby pressure may be simultaneously applied by said means to either of said connected pairs of cylinders while exhausting the other, bypass means between said connected pairs of cylinders comprising a casing, a pair of normally closed valves provided in said casing, and a communicating passage between said valves, said valves being so disposed that when one of said connected pairs of cylinders is subjected to pressure one of said valves is opened while the other is held in closed position, and when the other of said connected pairs of cylinders is subjected to pressure said last mentioned valve is opened and said first mentioned valve is held in closed position, a common operating member for said valves, means for actuating said member to open the valve held in closed position when the rams approach their limit of travel in one direction to thereby balance the pressures at each side of said motor, spring means for urging the valve held in open position by the application of fluid pressure to closed position when the pressures at each side of said motor become substantially balanced, and a second means for actuating said member to open the other of said valves held in closed position when the rams approach their limit of travel in the reverse direction to again balance the pressures at each side of said motor, and resilient means for urging the other of said valves held in open position by the application of pressure to closed position when the pressures at both sides of said motor again become substantially balanced.

13. In a device of the class described, the combination with a fluid motor comprising a ram, and a pair of cylinders embracing the opposite ends of said ram, of means for applying fluid pressure to either of said cylinders while exhausting the other, bypass means between said cylinders comprising a casing, a pair of normally closed valves provided in said casing, and a communicating passage between said valves, said valves being so disposed that when one of said cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said cylinders is subjected to pressure said last mentioned valve is opened, and said first mentioned valve is held in closed position, a common operating member for said valves, means for actuating said

member to open one of said valves held in closed position when the ram approaches its limit of travel in one direction to thereby balance the pressures at each side of said motor, a second
5 means for actuating said member to open the other of said valves held in closed position when the ram approaches its limit of travel in the reverse direction to again balance the pressures at each side of said motor, and means providing
10 a lost motion connection between said member and said valves to permit relative movement of said valves.

14. In a device of the class described, the combination of a fluid motor comprising a pair of
15 rams, and cylinders embracing the opposite ends of said rams, of means for applying fluid pressure to said cylinders, piping connecting the cylinders of one ram with the diagonally opposite cylinders of the other ram whereby pressure
20 may be simultaneously applied by said means to either of said connected pairs of cylinders while exhausting the other, bypass means between said connected pairs of cylinders comprising a casing, a pair of normally closed valves provided in

said casing, and a communicating passage between said valves, said valves being so disposed that when one of said connected pairs of cylinders is subjected to pressure one of said valves is opened, while the other is held in closed position, and when the other of said connected pairs of cylinders is subjected to pressure said last mentioned valve is opened and said first mentioned valve is held in closed position, a common
10 operating member for said valves, means for actuating said member to open one of said valves held in closed position when the rams approach their limit of travel in one direction to thereby balance the pressures at each side of said motor, a second means for actuating said member to
15 open the other of said valves held in closed position when the rams approach their limit of travel in the reverse direction to again balance the pressures at each side of said motor, and means providing a lost motion connection between said
20 member and said valves to permit relative movement of said valves.

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