Oct. 20, 1931. E. CANNON 1,828,643

HYDRAULIC OPERATING MECHANISM

Filed March 26, 1926 3 Sheets-Sheet 1

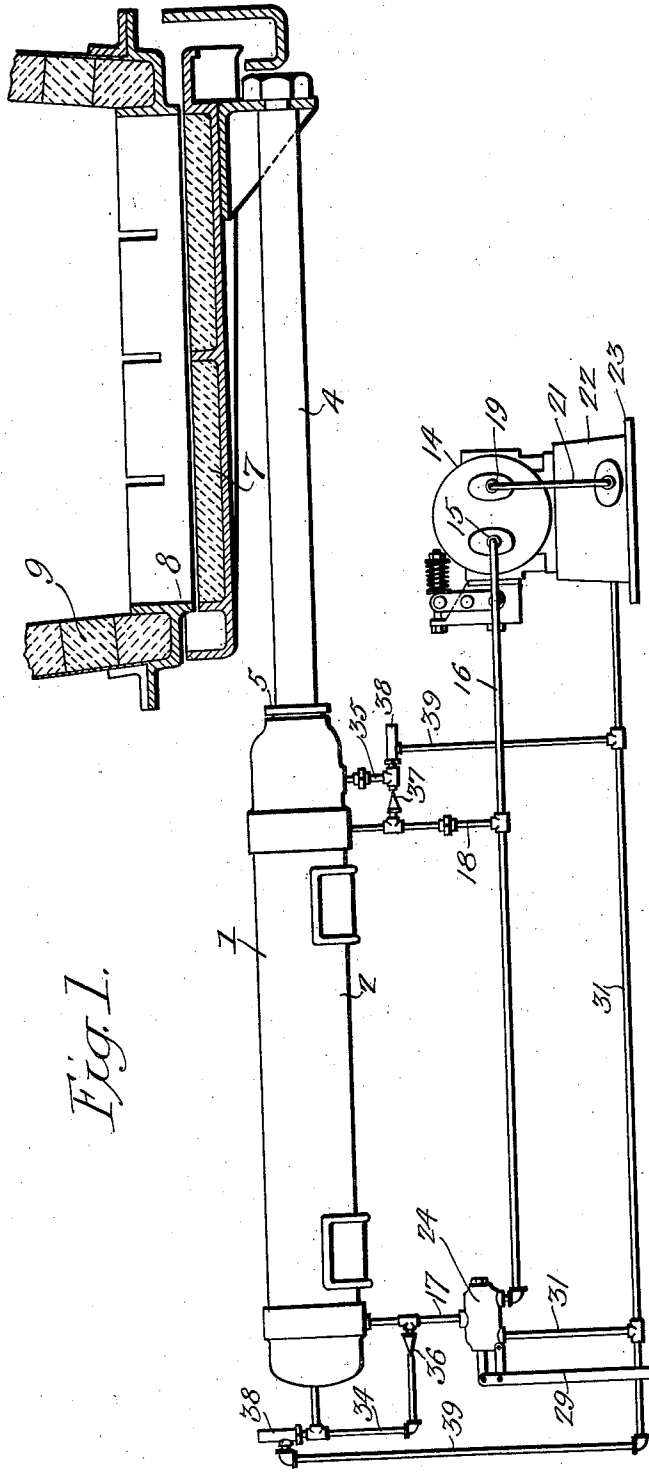

Fig. 1.

Inventor:
Earl Cannon,
by his Attorneys
Howson & Howson.

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HYDRAULIC OPERATING MECHANISM

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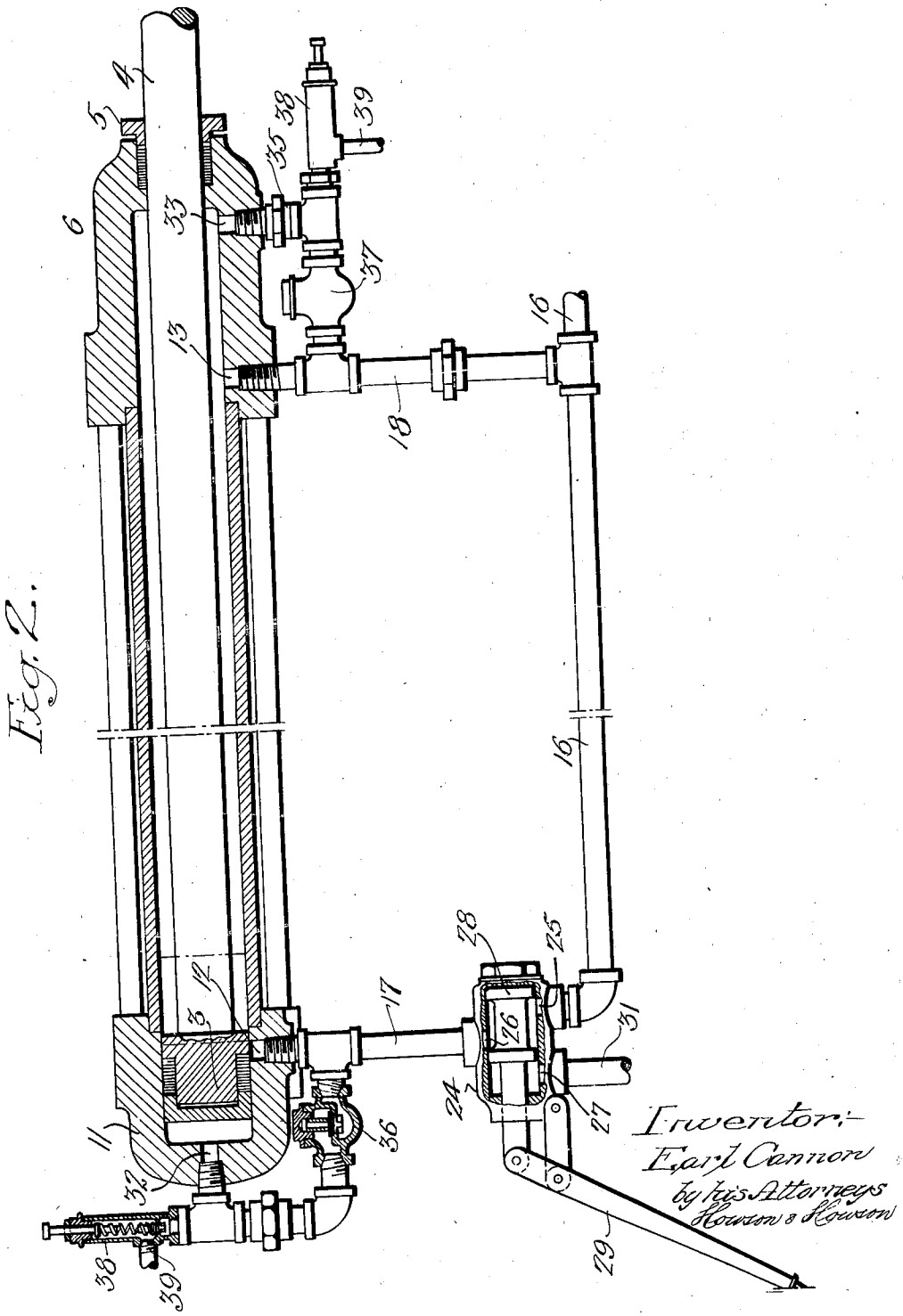

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HYDRAULIC OPERATING MECHANISM

Filed March 26, 1926 3 Sheets-Sheet 3

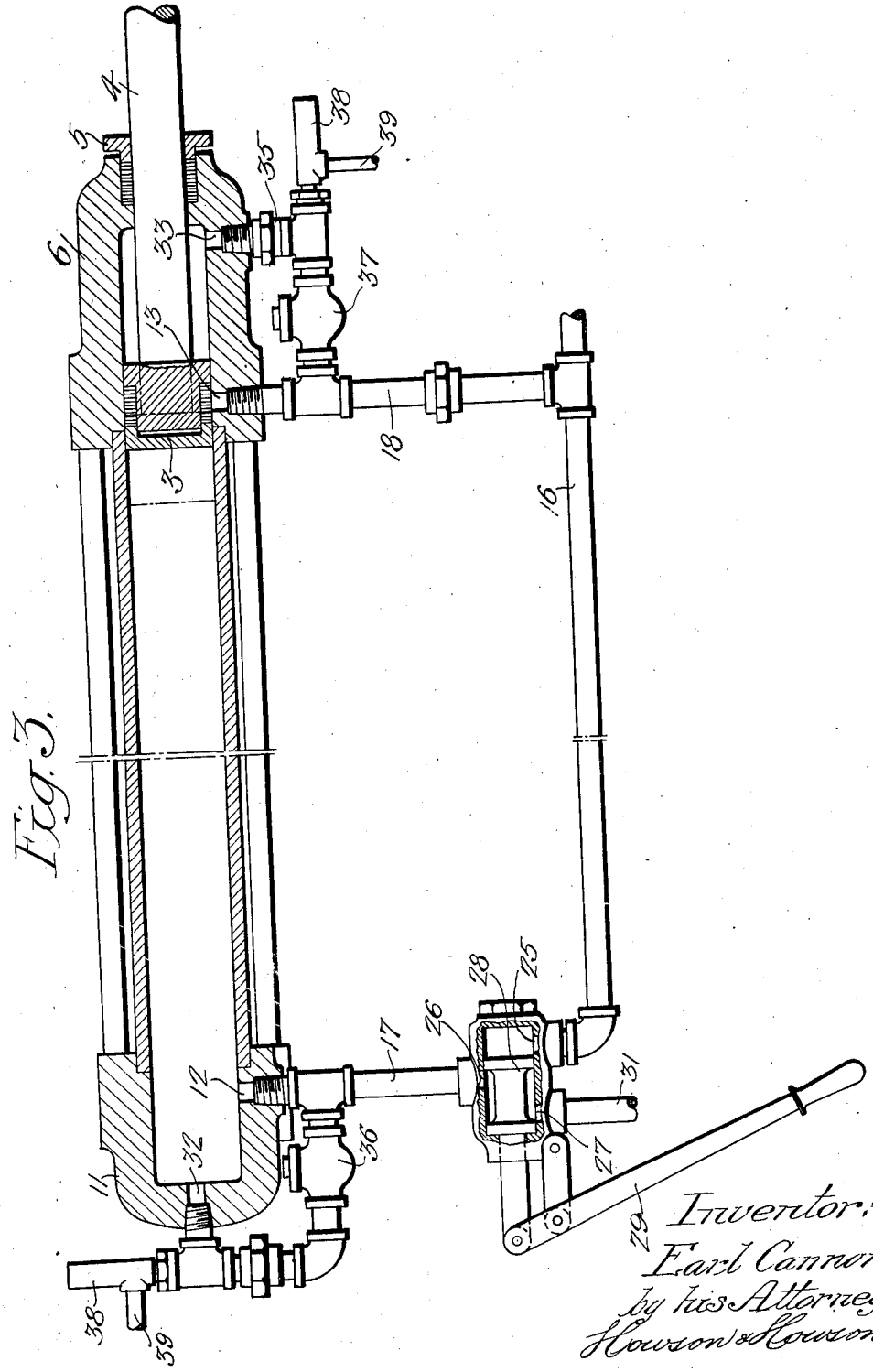

Fig. 3.

Inventor:
Earl Cannon
by his Attorneys
Howson & Howson

Patented Oct. 20, 1931 1,828,643

UNITED STATES PATENT OFFICE

EARL CANNON, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO AMERICAN FLUID MOTORS COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

HYDRAULIC OPERATING MECHANISM

Application filed March 26, 1926. Serial No. 97,797.

My invention relates to fluid-power apparatus, and it has for one object the provision of fluid-operating mechanism for ash gates and the like.

Another object of my invention is to provide a fluid power system, wherein a double-acting cylinder may be controlled by a three-way valve.

A further object of my invention is to provide a power system of the character described that shall include a fluid motor having equal piston speeds in opposite directions.

A still further object of my invention is to provide means, whereby the kinetic energy of the moving piston may be translated into heat energy when the piston is to be brought to rest,—the heat energy being carried away by the discharging motive fluid and the various parts thereby maintained at suitable operating temperatures.

With these and other objects and applications in mind, my invention further consists in the details of construction and operation hereinafter described and claimed and illustrated in the accompanying drawings, wherein

Fig. 1 is a side elevational view, partially in section, of one embodiment of my invention;

Fig. 2 is an enlarged detail view, partially in section, of the fluid motor and connected parts, the piston being in its extreme inner position and the three-way valve positioned to cause the piston to move to the right; and

Fig. 3 is a similar view but illustrating the position of the three-way valve when the piston is to be moved to the left.

Referring to the drawings, a fluid motor 1 comprises an elongated cylinder 2 having a piston 3 provided with a rod 4 which extends through a stuffing box 5 in an outer end 6 of said cylinder. The rod 4 is connected to an ash gate 7 which is operative to control an outlet opening 8 of ash-discharging apparatus 9. This application of my invention is given principally for the purpose of showing how varied may be the various forms thereof without departing from the fundamental features of my invention.

The cylinder 2 is provided at an inner end 11 with a main admission port 12 and at the outer end 6 with a main admission port 13. Fluid may be supplied to the main ports 12 and 13 by a pump 14 having a discharge port 15 connected to a pipe 16 provided with branches 17 and 18 which are respectively connected to the main ports 12 and 13. Thus propelling fluid may be supplied to both sides of the piston 2 and, by reason of the differential pressure areas resulting from the presence of the piston rod 4, the piston 3 moves from the closed end 11 of the cylinder 2 to the outer end 6 thereof, all as will presently appear. The pump 14, which may take the form of the Hele-Shaw and Martineau pump described in Patent No. 1,077,979, dated Nov. 11, 1913, has a suction port 19 connected by a pipe 21 to a storage chamber 22 formed in the bed plate 23.

My invention contemplates the operation of the double-acting fluid motor 2 by means of a three-way valve 24 having ports 25, 26 and 27. The valve 24 also has a movable element 28, whereby the port 26 may be connected to the port 25 or to the port 27 depending upon the position of an operating handle 29. The ports 25 and 26 are so associated with the branch 17 that the former is directly connected to the pump discharge port 15 and the latter to the main port 12. The port 27 may be connected to an exhaust pipe 31 which leads to the storage chamber 22.

When the valve element 28 is in the position shown in Fig. 2 and the piston 3 is in the dot-and-dash line position, the port 12 as well as the port 13 are directly connected to the pump discharge port 15, with the result that the piston 2 is actuated toward the outer cylinder end 6 at a speed proportional to the difference in pressure areas on the opposite sides of the piston 3. However, when the three-way valve 24 is in the position shown in Fig. 3 and the piston 3 occupies the dot-and-dash line position, the port 13 only is connected to the pump discharge port 15 since the port 12 is now connected to the exhaust pipe 31. As a result, the piston 3 is moved toward the closed end 11 of the cylinder 2. The resulting discharge from the closed end 11 is carried by the exhaust pipe 31 to the

storage chamber 22 and subsequently conveyed through the pipe 21 to the suction port 19 of the pump 14.

It is desirable in certain classes of work, for example, that illustrated in the drawings, that the speed of the piston 3 shall be equal for both forward and return strokes for equal pump discharges. To this end, I so design the parts of the fluid motor 1 that the area represented by the difference between the cross-sectional area of the piston 3 and the piston rod 4 is equal to the cross-sectional area of the piston rod 4. The reason for such proportions is apparent in view of Figs. 2 and 3, since for one position of the three-way valve 24, fluid is delivered to both sides of the piston 3 while for another position, fluid is delivered to one side only, the other side being connected to the exhaust pipe 31.

The main admission ports 12 and 13 are so positioned in the path of travel of the piston 3 as to be closed by said piston as it moves into its extreme positions. These positions are illustrated in Figs. 2 and 3. In order to cause the movement of the piston 3 from these extreme positions, I provide auxiliary ports 32 and 33 which are respectively connected through pipes 34 and 35 to the branch pipes 17 and 18. The pipe 34 is connected to the portion of the branch 17 intermediate the port 26 of the three-way valve 24 and the main admission port 12. Check valves 36 and 37 are respectively included in the pipes 34 and 35, whereby fluid may pass through said pipes to the ports 32 and 33 when the main admission ports 12 and 13 are closed by the piston 3.

A further feature of my invention is the translation of the kinetic energy of the moving piston 3 and associated parts into heat energy when the piston 3 approaches the end of its stroke, whereby said piston may be quickly and easily brought to rest with a minimum of vibration. This desired result is accomplished by connecting relief valves 38 in pipes 39 which respectively extend from the auxiliary port side of the check valves 36 and 37 to the exhaust pipe 31. Each relief valve is set to operate at such pressure that the volume of oil discharged therethrough under pressure contains the same amount of energy as in the piston 3 and associated moving parts. Thus, each relief valve presents a variable orifice having a maximum opening when the pressure is greatest and decreasing correspondingly with the pressure.

In operation, assuming the three-way valve 24 in the position shown in Fig. 2, fluid is delivered to the inner end 11 of the cylinder 2 through the branch pipe 17, the three-way valve 24, the check valve 36, the pipe 37 and the auxiliary port 32. Fluid is also delivered to the outer end 6 of the cylinder 2 through the branch pipe 18 and the main admission port 13. As a result, the piston 2 is moved to the right. When the inner main admission port 12 is uncovered, fluid is supplied to the cylinder end 11 through this port rather than the auxiliary port 32. The movement of the piston 3 continues until the outer main admission port 13 is closed, whereupon the piston 3 and associated parts are brought to rest by the discharge of the fluid from the outer end 6 of the cylinder 2 through the relief valve 38. This method of absorbing the shock incident to suddenly stopping the piston 3 is particularly advantageous in fluid systems employing oil rather than air, inasmuch as oil is substantially incompressible and would cause the development of excessive pressures should the usual compression methods of stopping the piston 3 be employed. The kinetic energy of the moving piston 3 is thus translated into heat energy in the relief valve which is carried off by the fluid to the storage chamber 22.

When the piston 3 is to be moved to the inner end 11 of the cylinder 2, the operating lever 29 of the three-way valve 24 is moved from the position shown in Fig. 2 to that shown in Fig. 3, wherein the inner main admission port 12 is directly connected to the exhaust pipe 31. Since the outer main admission port 13 is closed by the piston 3, fluid is supplied to the outer end 6 of the cylinder 2 through the branch pipe 18, the check valve 37, the pipe 35 and the auxiliary port 33. The piston 3 is now moved toward the inner end 11 of the cylinder 2, finally closing the inner main port 12 and discharging the remaining fluid through the inner relief valve 38 when the kinetic energy of the piston 3 and associated parts is translated into heat energy that is carried by the discharging fluid to the storage chamber 22.

While I have shown only one form of embodiment of my invention, for the purpose of describing the same and illustrating its principles of construction and operation, it is apparent that various changes and modifications may be made therein without departing from the spirit of my invention and I desire, therefore, that only such limitations shall be made thereon as are indicated in the appended claims or as are demanded by the prior art.

I claim:

1. A fluid motor having a pair of main ports, and a fluid-impelled member having different effective pressure areas respectively operatively related with said ports; a pump having a discharge port and a suction port, means for connecting said discharge port to that one of said main ports related to the lesser of said effective pressure areas and the other main port to said suction port and thereafter connecting said discharge port to both of said main ports, auxiliary ports adjacent to said main ports, means including relief valves for connecting said auxiliary

ports to said suction port, and means including check valves, whereby said auxiliary ports may be connected to said pump discharge port.

2. Apparatus comprising a cylinder provided with a piston having different effective pressure areas at opposite sides, and main ports for admitting actuating fluid to the opposite sides of said piston, an auxiliary port for each main port, a pump having discharge and suction ports, a pipe system including independent branches connecting the main ports of the cylinder with the discharge port of the pump, a bypass from each of said branches to the adjacent auxiliary port, a check valve in each of said bypasses, a three-way valve confined entirely to that branch which feeds the cylinder on the side of the piston of greater effective area and adapted in alternative positions to connect the associated main port with the discharge and suction ports of the pump respectively, a bypass from each of said auxiliary ports to the suction port of the pump, and a loaded valve in each of the last-named bypasses.

3. In a closed fluid system, the combination with a cylinder having main ports, and a fluid-actuated piston within said cylinder, said ports being positioned to be closed by the piston as the latter approaches the ends of its stroke respectively, of a pump, and means providing for actuation of the piston through the medium of fluid pressure from said pump applied to said main ports, an auxiliary port for each of said main ports also connected with the discharge of said pump for application of fluid pressure to the cylinder when the respective associated main ports are closed by said piston, a loaded relief valve for each of the auxiliary ports, and means controlled by said valves for connecting the auxiliary ports with the pump suction.

EARL CANNON.