

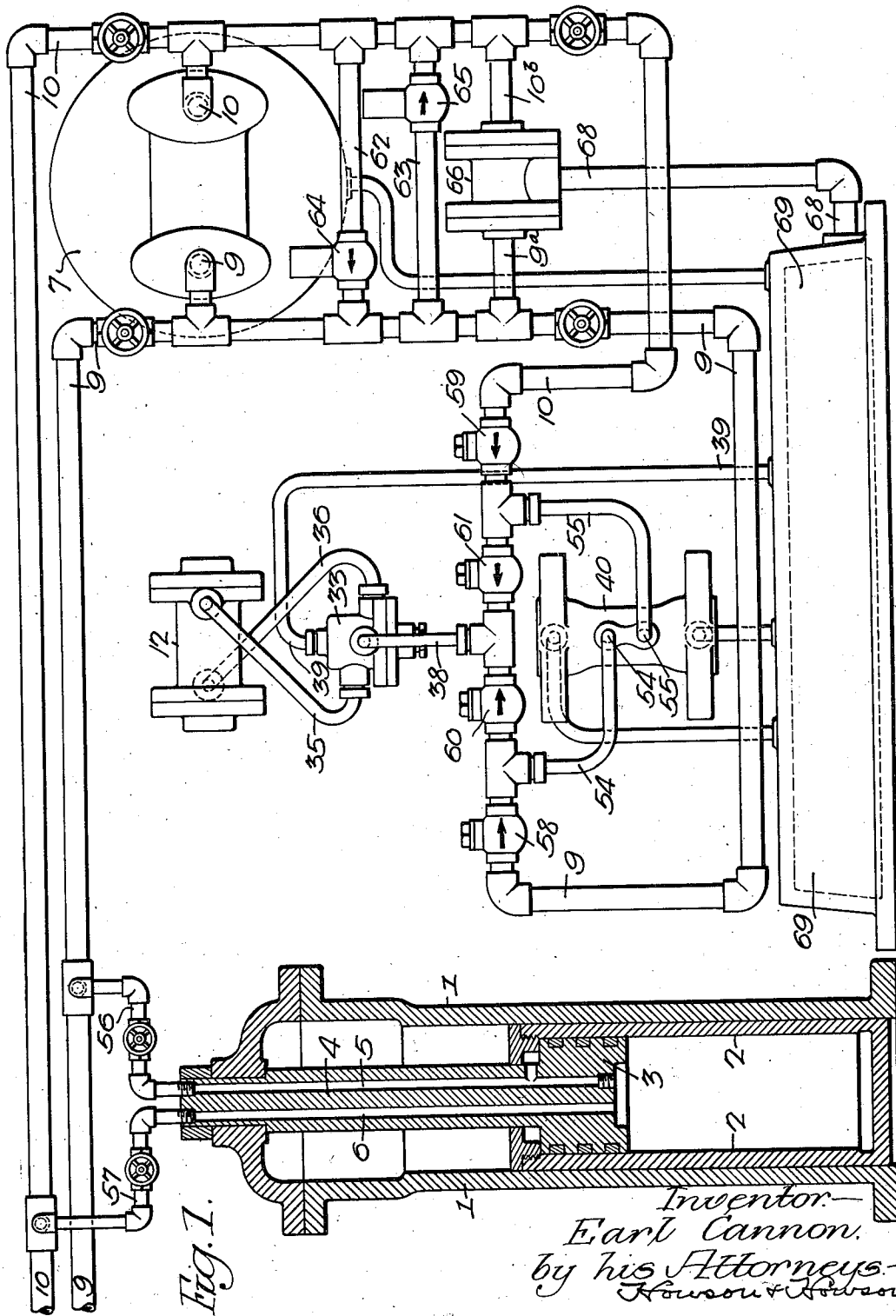
Aug. 9, 1927.

E. CANNON

HYDRAULIC MECHANISM

Filed May 25, 1923.

6 Sheets-Sheet 1

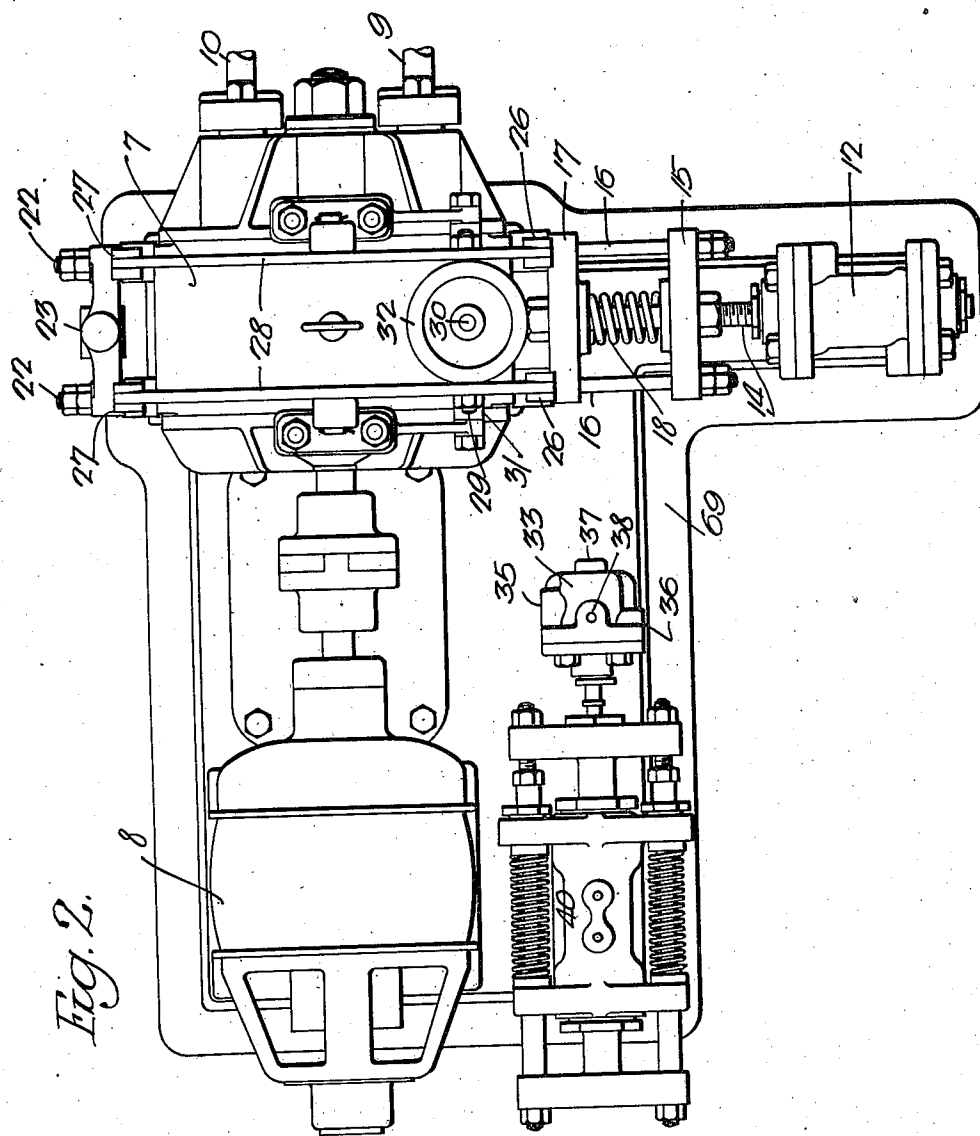


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HYDRAULIC MECHANISM
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1,638,653

6 Sheets-Sheet 2



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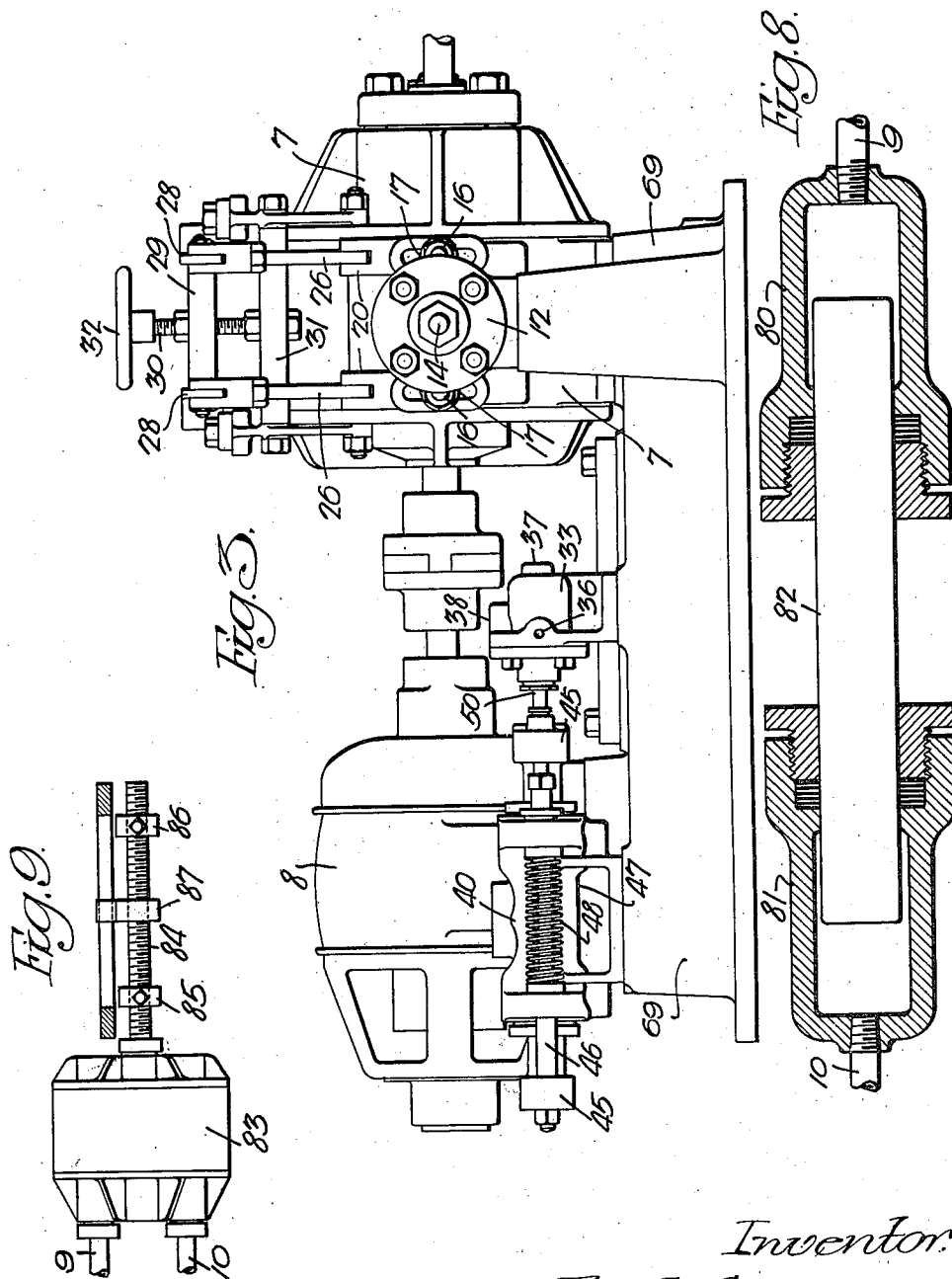
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6 Sheets-Sheet 3



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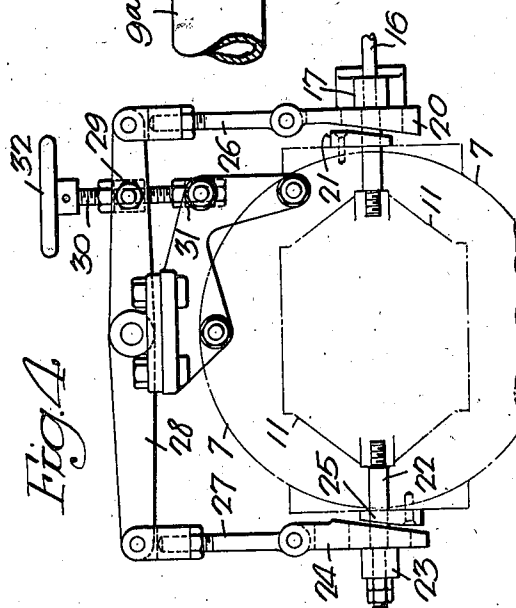
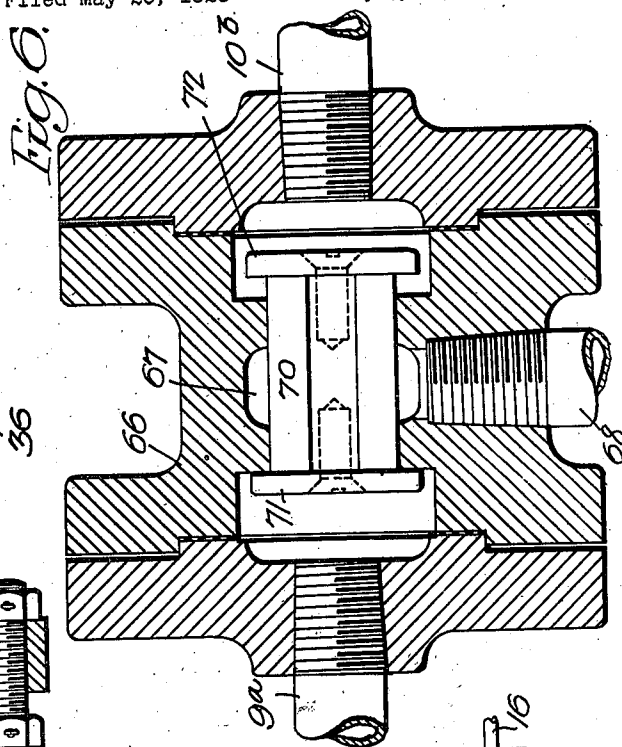
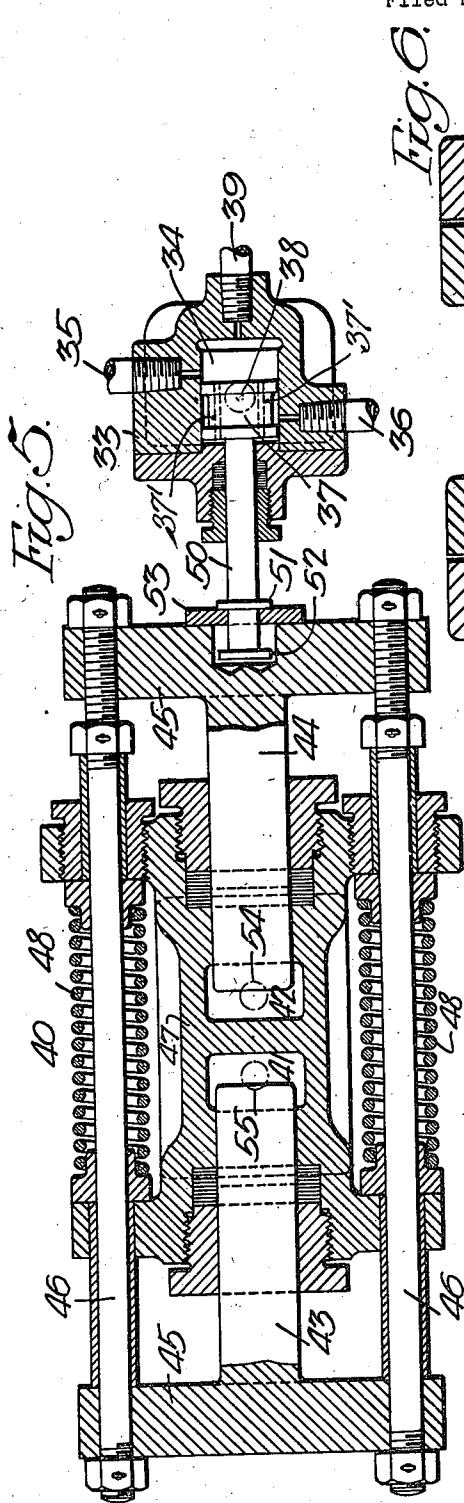
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6 Sheets-Sheet 4



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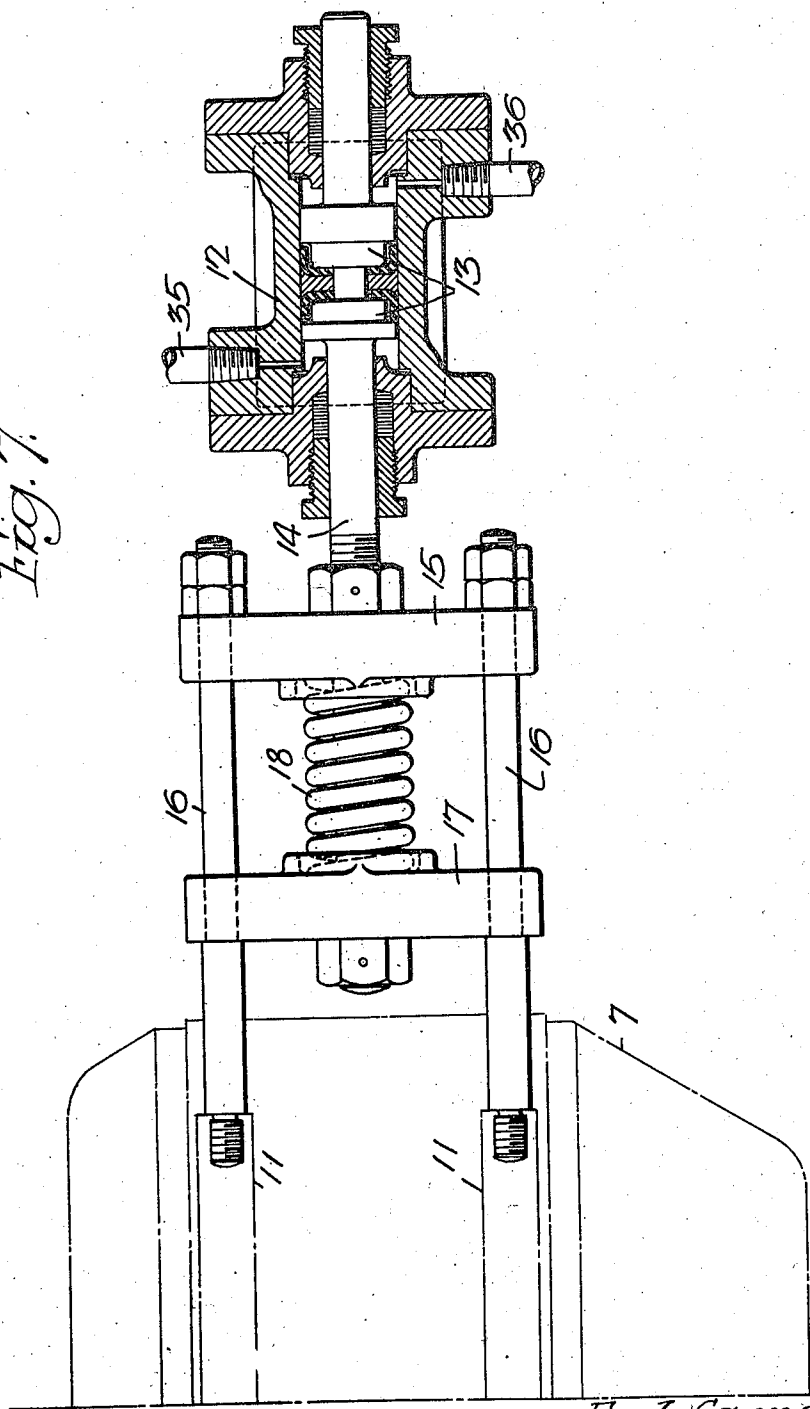
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6 Sheets-Sheet 5

Fig. 7.



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6 Sheets-Sheet 6

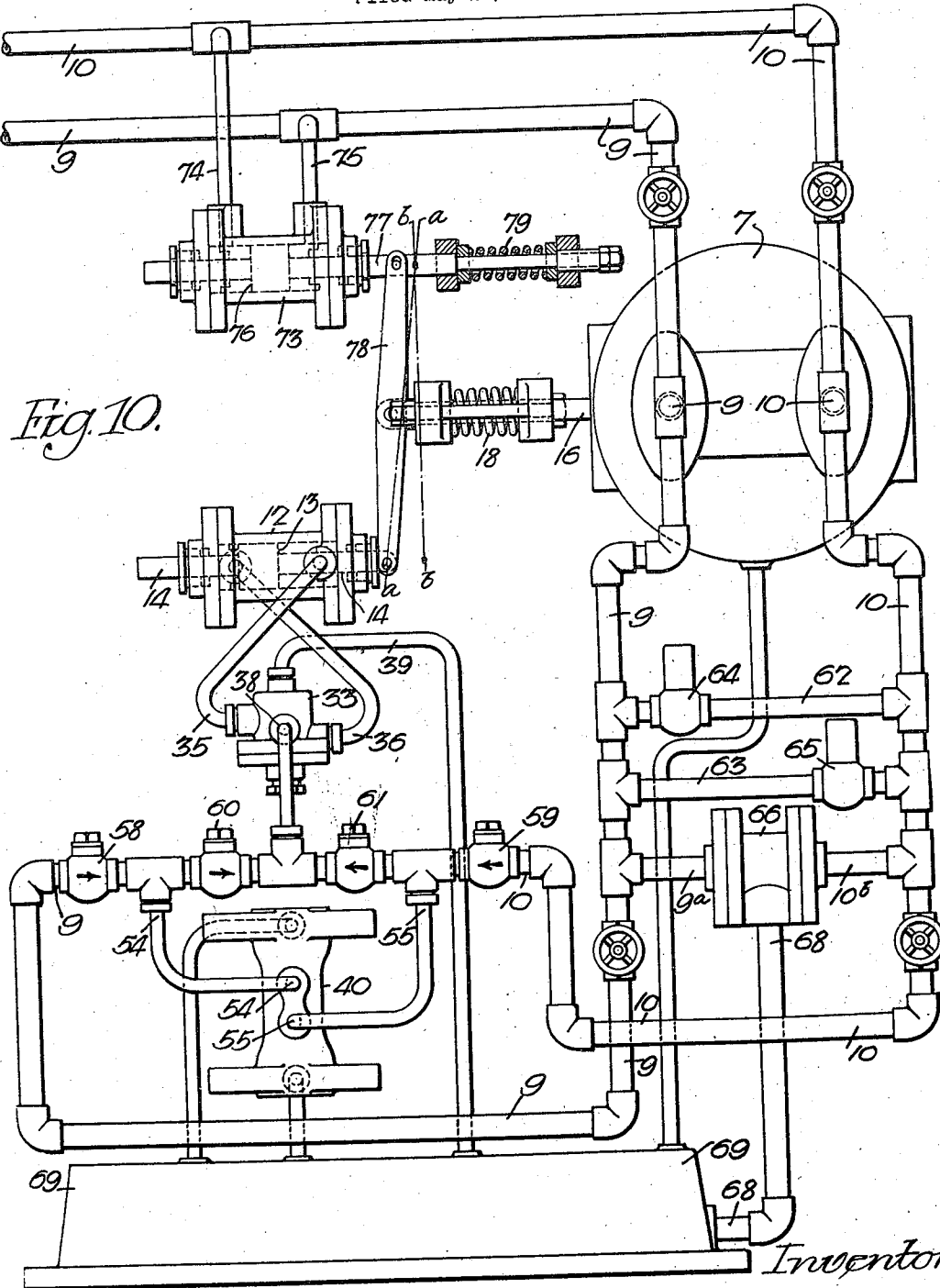


Fig. 10.

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UNITED STATES PATENT OFFICE.

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HYDRAULIC MECHANISM.

Application filed May 25, 1923. Serial No. 641,443.

One object of this invention is to provide a simple, economical, compact and reliable combination of apparatus for automatically controlling the supply of liquid under pressure to a hydraulic motor and more particularly for alternately delivering such liquid to and exhausting it from the opposite ends of a cylinder such as one designed to actuate the fuel feeding ram of an automatic stoker.

A further object of my invention is to provide novel means for automatically reversing the direction of flow of liquid delivered from a continuously driven pump and the invention contemplates reliable and durable means whereby the times of such reversal are made to be dependent on the pressure of said liquid, occurring when said pressure is increased to or beyond a predetermined point.

I also desire to provide novel means for automatically reversing the direction of flow of liquid delivered from a continuously driven pump to the opposite ends of a motor cylinder, together with means for automatically compensating for the differences in volume of the two ends of said motor cylinder.

Another object of my invention is to provide a novel form of pressure operated relay mechanism for automatically causing reversal of the direction of flow of liquid delivered by a continuously operating pump.

These objects and other advantageous ends I attain as hereinafter set forth, reference being had to the accompanying drawings, in which,

Fig. 1 is a diagrammatic plan, partly in horizontal section, illustrating a system of apparatus arranged in accordance with my invention;

Fig. 2 is a plan of the continuously driven pump with its associated prime mover and certain of the devices associated with said pump in accordance with my invention;

Fig. 3 is a side elevation of the apparatus shown in Fig. 2;

Fig. 4 is a side elevation of the stroke controlling attachment for the continuously operative pump shown in Figs. 2 and 3;

Fig. 5 is a horizontal section taken through the longitudinal center line of the controller and its associated valve;

Fig. 6 is a longitudinal section of the shuttle valve;

Fig. 7 is a horizontal longitudinal section of the motor for actuating the stroke-controlling element of the continuously driven pump;

Fig. 8 is a horizontal longitudinal section of one form of motor which may be operated by means of my invention;

Fig. 9 is a plan partly in section of another form of motor; and,

Fig. 10 is a diagrammatic view, partly in section illustrating a modified arrangement of the apparatus constituting my invention.

In Fig. 1 of the above drawings, 1 represents a casing constituting an elongated guideway designed for connection to the outer or forward end of a retort of an automatic stoker, for which purpose it is open and outwardly flanged at one end and has reciprocable within it a hollow cylindrical ram 2. This ram coacts with a stationary piston 3 supported by a rod or stem 4 from the outer end of the casing 1. The opposite ends of the said cylinder are supplied with liquid under pressure through passages 5 and 6 extending through said rod 4. The apparatus hereinafter described is primarily designed to alternately supply liquid under pressure to and exhaust it from the opposite ends of the cylinder 2 through the passages 5 and 6. Said apparatus comprises primarily a suitable pump 7 continuously driven in one direction by a source of power such as the electric motor 8. This pump is preferably of the type described and claimed in patent to Hele-Shaw and Martineau, No. 1,077,979 dated November 11, 1913 and includes a shiftable element whereby the quantity and direction of the flow of liquid will be varied through two conduits 9 and 10,—the arrangement being such that when the shiftable element indicated at 11 (Fig. 4) is moved in one direction, liquid is delivered under pressure through the conduit 9 and is drawn into the pump through the conduit 10, while when said element is shifted in the opposite direction, fluid is delivered through the conduit 10 and drawn in through the conduit 9. In the middle position of the shiftable element 11, there is no flow through either of said conduits,

For actuating the shiftable member 11 of the pump 7, I provide a motor in the form of a cylinder 12 having a piston 13 connected by a rod 14 to a cross bar 15. The latter is slidably mounted on a pair of rods 16—16 on which is fixed a second cross bar 17, and a coil spring 18 is confined between the said cross bars 15—17 so as to cushion the action of the motor piston 13 on the rods 16. Said rods 16—16 are connected to the shiftable element 11 of the pump 7 and in order to make possible the adjustment of the throw or displacement of said element under the action of the piston 13, I mount on said rods wedges 20 adjustable between the cross bar 17 and suitable abutments 21 on the adjacent portion of the pump casing.

In order to provide for the regulation of the movement of said element 11 in both directions, I connect to it a second pair of rods 22—22 on the opposite side from and aligned with the rod 16 and connect them by a suitable cross bar 23. A second pair of wedges 24—24 is provided on the rods 22 so as to be adjustable between the cross bar 23 and abutments 25 in the pump casing. The two pairs of wedges 20 and 24 are hung through links 26—27 from a pair of levers 28—28 fulcrumed on top of the casing of the pump 7 and connected by a cross bar 29 (Fig. 3). A screw 30 swivelled to a suitable bracket 31 is threaded through the cross bar 29 and provided with an operating handle 32 in the form of a hand wheel fixed to its upper end. The two sets of wedges 20 and 24 are oppositely set so that swinging of the levers 28—28 on their supporting fulcra by rotation of the screw 30 simultaneously increases or diminishes the distance between the cross bar 17 and the abutments 21 and between the cross bar 23 and the abutments 25 and thus regulates the distance through which it is possible to displace the adjustable stroke-controlling element 11 of the pump 7 from its mid or neutral position. Thus, the raising of the wedges 24 and the simultaneous lowering of the wedges 20 will increase the possible movement of the element 11 to either side of its neutral position.

For controlling the supply liquid under pressure to the cylinder 12, I provide a valve 33 (Fig. 5) having a cylindrical chamber 34 one end of which, through a conduit 35, is connected to one end of said cylinder 12 while its opposite end is connected through a second conduit 36 to the second end of said cylinder. Within the chamber 34 is mounted a piston valve 37 having axial perforations 37', whereby when the piston valve 37 is in one position it permits fluid under pressure to flow from a supply pipe 38 through the conduit 36 while at the same time permitting liquid under pressure to exhaust from the conduit 35 into the exhaust pipe 39. When the piston valve 37 is in its other extreme

position, it permits fluid under pressure to flow into the conduit 35 and exhaust from the conduit 36 through the perforations 37'.

For actuating the piston valve 37, I provide a pressure responsive controller (indicated at 40 in Fig. 5) which consists essentially of a casing having two chambers 41 and 42, into which extend two plungers 43 and 44 respectively. The latter have suitable stuffing boxes where they enter said chambers and are connected through cross heads 45—45 to a pair of parallel bars 46—46 slidably guided in the bearings provided by structure 47 which has the chambers 41 and 42. Springs 48—48 are mounted on the bars 46—46 in such manner as to tend to retain the plungers 43 and 44 in as well as return them to mid or neutral positions, and said plungers are connected with the piston valve 37 through a rod 50. The latter is provided with two collars 51 and 52 on opposite sides of and separated from a third collar 53 fixed to one of the cross bars 45 and the arrangement is such that movement of the plungers 43 and 44 in one direction from their mid or neutral position will move the piston valve 37 from one to the other of its extreme positions but will not retard it in returning to the mid position. The two chambers 41 and 42 are connected to fluid supply pipes through conduits 54 and 55, which in a typical case, are arranged as shown in Fig. 1. The two conduits 9 and 10 of the pump 7 are connected through branch pipes 56 and 57 with the passages 5 and 6, respectively, for supplying the cylinder 2. The conduit 9 is also connected through a check valve 58 with the conduit 54 supplying the chamber 42 of the controller 40, while the conduit 10 is similarly connected to the conduit 55 supplying the chamber 41 of said controller through a check valve 59. Said two conduits 9 and 10 through a pair of check valves 60 and 61 are both connected to the supply conduit 38 of the valve 33. I preferably also connect said two conduits 9 and 10 through branches 62 and 63 of which the first contains a safety valve 64 for relieving abnormal pressure in the conduit 10 and the second contains a safety valve 65 for relieving abnormal pressure in the conduit 9.

In order to provide for the difference in volume or capacity of the opposite ends of the cylinder 2, I connect between the conduits 9 and 10 a shuttle valve 66 (shown in detail in Fig. 6) making this in the form of a cylinder whose opposite ends are respectively connected to the two conduits 9 and 10. Said cylinder in addition has a central port 67 connected through a pipe 68 with a suitable tank 69 into which surplus liquid may be discharged and from which it may be drawn when required. Within the cylinder of the shuttle valve

66, I mount a movable valve element 70 consisting of a pair of discs 71 and 72, connected by a guide spindle and so constructed that when in one extreme position it permits communication between the pipe 9^a leading to the pipe 9 and the pipe 68, while communication is cut off between said latter pipe and the pipe 10^b connected to the pipe 10. In the other position as illustrated in Fig. 6, communication is permitted under the disc 72 to the pipe 10^b and the pipe 68 and is cut off by the disc 71 between the pipe 9^a and the pipe 68.

With the above described arrangement of parts, if it be assumed that the electric motor 8 is supplied with current, then as long as the element 11 of the pump 7 is in its mid position, the rotor of said pump is actuated without moving fluid through pipes 9 and 10. If now the element 11 be displaced to the left (Figs. 4 and 7) for example, the pump 7 will deliver fluid under pressure into the pipe 9 through pipe 56 and passage 5 into the outer end of the cylinder 2. As a result, the cylinder 2 is moved toward the closed or outer end of the casing 1 and fluid (which it is assumed fills the inner or opposite end of said cylinder as well as all the piping) is exhausted through the passage 6 and is drawn through the conduit 10 into the pump 7. Since, however, this inner end of the cylinder has a greater volume than the outer end which is being filled by fluid under pressure, there is an excess of fluid forced toward the pump 7, and since the fluid under pressure in the pipe 9 acts through the pipe 9^a against the disc 71 this latter assumes the position shown in Fig. 6, allowing the excess of liquid to flow from the pipe 10 through the pipe 10^b, under the disc 72 into the pipe 68 and to the tank 69. The above described action continues until such time as the cylinder 2 has completed its stroke when obviously its further movement is impossible and owing to the continued operation of the pump 7 the pressure of liquid in the pipe 9 is materially increased. Such increase naturally occurs also in the pipe 54 and in the chamber 42 of the controller 40 connected thereto. As a consequence, the plunger 44 is moved out of said chamber against the action of the springs 48—48 so that its cross head 45 acts through the collars 53 and 51 on the rod 50 and shifts the valve 37 from the position shown in Fig. 5 to its extreme right hand position. Thereupon fluid under pressure from the pipe 9 is free to flow through the pipe 38 and cavity of the valve 33, into the pipe 35, thus admitting said fluid to the motor cylinder 12, Fig. 7 and causing shifting of the piston 13 to the right. This movement is made possible by reason of the connection of the pipe 36 through the axial perforations 37

in the valve element 37 with the exhaust pipe 39.

The adjustable element 11 of the pump which is connected to the piston 13 is thus shifted from one extreme position to the other so that fluid under pressure is delivered to the pipe 10 and drawn into the pump from the pipe 9. The resulting reduction of pressure permits the springs 48 to return the plunger 44 to its mid position, although this action occurs without effecting the valve element 37, since the collar 53 on the cross head 45 does not engage either of the collars 51 or 52. Fluid under pressure thereupon flows from the pipe 10 through the passage 6 into the inner end of the cylinder 2, causing this to move inwardly toward the position shown in Fig. 1, while fluid is drawn from the opposite end of said cylinder through the pipes 5 and 9 into the pump.

Since the capacity of the inner end of the cylinder 2 is greater than that of the outer end, the liquid required to make up the difference is supplied to the pump 7 by the action of the shuttle valve, whose movable element 70 is acted on by fluid under pressure from the pipes 10 and 10^b when said pump is reversed, so that pipe 9^a is connected to the pipe 68 whereupon liquid is drawn from the tank 69 through these pipes into pipe 9 as required.

Liquid continues to be supplied under pressure to the inner end of the cylinder 2 until this has been moved to the position shown in Fig. 1, whereupon the sudden increase in pressure in the pipe 10 and hence in the pipe 55 results in the plunger 43 being moved outwardly from the chamber 41 against the action of the springs 48 so as to shift the movable element 37 of the valve 33 back to the position shown in Fig. 5. The piston 13 of the motor 12 is thus again actuated and the movable element 11 of the pump 7 shifted to its other extreme position in which fluid under pressure is delivered to the pipe 9 and drawn in to the pump from the pipe 10.

The above described cycle of operations will be repeated as long as the pump 7 is operated by its motor 8, thus automatically causing the reciprocation of the cylinder 2 and in the case illustrated causing this element to intermittently feed fuel into the retort of a furnace. Obviously, any desired number of similar reciprocable or other motor units may be connected to the pipes 9 and 10, which with their associated pump and motor are made of the capacity requisite for the work they are called upon to perform.

If it be found dangerous or objectional to permit of the relatively high pressure and sudden shifting of the movable pump element 11 incident upon the arrangement of

apparatus above described, I may without departing from my invention utilize the combination of mechanism shown in Fig. 10, wherein I provide an auxiliary controller 73 in the form of a cylinder connected through pipes 74 and 75 to the pressure supply pipes 9 and 10. This cylinder contains a piston 76 which through a rod 77 is connected to one end of a floating lever 78, fulcrumed at or adjacent its middle point to a rod in every way similar to the rod 14, Fig. 7, and like it connected through a cushion spring 18 with the operating rods 16 of the movable pump element 11. The opposite end of the lever 78 is connected to the piston rod 14 of the motor 12 and the rod 77 with the piston 76 is acted on by a centering spring 79 so that it tends to return to or remain in a mid or neutral position.

With this arrangement of parts, when the operation of the pump 7 causes fluid under pressure to be delivered to the pipe 10 for example, the gradual increase in pressure of said pipe during the continued delivery of liquid to the cylinder 2 will cause the piston 76 of the auxiliary controller 73 to be moved toward the right against the action of the spring 79, while the piston 13 of the motor 12 remains in its extreme left hand position. As a consequence, the lever 78 moves toward and finally into position indicated by the dot and dash line *a-a*, Fig. 10, thus so moving the rods 16 that the controlling element 11 of the pump is shifted gradually toward its mid or neutral position. The amount of fluid delivered by the pump 7 to the pipe 10 is thus gradually decreased, until when finally the cylinder 2 reaches the extreme end of its stroke, the resultant increase in pressure in the pipe 10 is not so great and the operation of the apparatus is not so violent as in the case previously described. The piston 13 of the motor 12 is as before moved to the right, thus shifting the lever 78 into position *b-b* and reversing the pump 7 so that liquid under pressure is delivered to the pipe 9 and the above described cycle of operations is indefinitely repeated.

As will be understood by those skilled in the art, I may employ any of a number of different types of motors in place of the motor 2-3 shown in Fig. 1, since as shown in Fig. 8 for example, I may connect the pipes 9 and 10 to a pair of cylinders 80 and 81 and so mount these that a single plunger 82 connected to any desired form of apparatus may have its opposite ends extending into them obviously, the alternate delivery of liquid to and its exhaust from these cylinders will result in reciprocation of the plunger 82 and the actuation of the mechanism connected thereto. On the other hand, I may connect the pipes 9 and 10 to any suitable form of rotary motor 83 (Fig. 9) and adjustably control the length of time

for which said motor is actuated in each direction by providing its rotor with a threaded shaft 84 carrying adjustable stops 85 and 86 fixed to it at any desired distances apart. Also mounted on the shaft 84 is a nut 87 and it is obvious that when by rotation of said shaft said nut 87 is caused to engage either one of the stops, the resulting increase in load on the motor 83 will likewise increase the pressure in one of the pipes 9 or 10, so that the flow of liquid in these latter is reversed as above described with a consequent reversal of the motor 83. By adjusting the distance between the stops 85 and 86, I may vary the number of revolutions of the motor 83 and hence the time elapsing between each of the reversals thereof.

I claim:

1. The combination of a continuously operating pump; a motor connected to be driven by fluid propelled by said pump; with pressure actuated means for automatically reversing the direction of flow of fluid delivered by said pump, to periodically reverse the motor.

2. The combination of a continuously operating pump; two pipes for said pump; a motor connected to said pipes; and a device connected to be actuated by changes in pressure of liquid in said pipes for automatically reversing the direction of flow of liquid therein.

3. The combination of two pipes; a pump operatively associated therewith and including an element for reversing the direction of a flow of liquid in said pipes; a motor connected to be actuated by liquid flowing through said pipes; and pressure responsive means for operating the flow reversing element.

4. The combination of two pipes; a pump operatively associated with said pipes; an element for reversing the direction of flow of liquid in said pipes; a motor mounted to be actuated by liquid flowing through said pipes; and means actuated by liquid under abnormal pressure in either of said pipes for operating the flow reversing element.

5. The combination of two pipes; a pump operatively associated therewith and including an element for reversing the direction of a flow of liquid in said pipes; a motor connected to be actuated by liquid flowing through said pipes; and pressure responsive means for operating the flow reversing element; with a device for varying at will the time elapsing between successive operations of the pressure responsive means.

6. The combination of two pipes; a pump operatively associated therewith and including an element for reversing the direction of flow of liquid in said pipes; a motor mounted to be actuated by liquid flowing through said pipes; pressure responsive

means for operating the flow reversing element; with a device for adjusting the displacement of the flow reversing element on either side of a neutral position to vary the time elapsing between successive operations.

7. The combination of a continuously operating pump; a main motor connected to be actuated by fluid under pressure from said pump; an auxiliary motor connected to cause reversal of the direction of flow of fluid delivered by the pump; a valve controlling said auxiliary motor; and a device responsive to variations in pressure of the fluid delivered by the pump, for actuating said valve.

8. The combination of a continuously operating pump; a main motor connected to be actuated by fluid propelled by said pump; an auxiliary motor for causing reversal of the direction of flow of fluid delivered by said pump; a valve for controlling the operation of said auxiliary motor; and a device for operating the valve connected to be actuated by fluid delivered from the pump when the pressure of said fluid increases to a predetermined amount.

9. The combination of a continuously operating pump; a fluid motor; two pipes connecting said pump to the motor; an auxiliary motor for causing reversal of the direction of flow of fluid in said pipes; a valve for controlling the operation of the auxiliary motor; and a device connected to said pipes including an element operative to actuate said valve when the pressure of fluid in either pipe exceeds a predetermined amount.

10. The combination of a pump; a reversible fluid motor connected to said pump and having a greater capacity for fluid when operated in one direction than when operated in the opposite direction; means for automatically reversing the direction of flow of fluid to said motor upon a predetermined rise of pressure of the fluid delivered by said pump; and a valve responsive to fluid pressure automatically operable to permit the escape of excess fluid when the motor is operated in one direction and to permit the supply of the deficiency of fluid occurring when said motor is operated in the opposite direction.

11. The combination of a continuously operating pump with a reversible fluid motor; two pipes connecting said motor with the pump; means for periodically reversing the direction of fluid flow in said pipes to cause reversal of the motor; and a valve responsive to pressure for permitting the escape of surplus fluid when the motor is operated in one direction and for permitting the supply of fluid to make up the deficiency thereof when said motor is operated in the reverse direction.

12. The combination of a continuously operating pump including a shiftable element

for reversing the direction of flow of liquid delivered; a motor for actuating said shiftable element; and a device responsive to abnormal pressure of the liquid delivered by the pump for controlling the operation of said motor.

13. The combination of a continuously operating pump including a shiftable-flow-direction-controlling element; a motor for operating said element; a valve for controlling said motor; a cylinder connected to receive liquid from said pump; a piston in said cylinder operatively connected to said valve; with spring means normally holding said piston in a neutral position but permitting its movement to actuate the valve when the pressure of liquid delivered to the cylinder is increased to a predetermined point.

14. The combination of a continuously operating pump; a motor having a reciprocating element including as part thereof a cylinder, the two ends of which have different capacities; pipes connecting said motor with the pump; means for causing reversal of the flow of fluid from the pump to the motor; a tank; and an automatic pressure responsive valve connected to deliver fluid to the tank when the movable element of the motor is being driven in one direction, and to cause fluid to be drawn from the tank into said pipes when said motor is being operated in the opposite direction.

15. The combination in a continuously operating pump including a shiftable-flow-direction-controlling element; automatic means for actuating said element connected to be operative upon a predetermined rise of pressure of the liquid delivered by said pump; and means operative to gradually reduce the flow of liquid delivered by said pump prior to the operation of said first means.

16. The combination of a continuously operating pump including a shiftable-flow-direction-controlling element; a motor for operating said element connected to be actuated by a predetermined rise of pressure of liquid delivered by the pump; and an auxiliary motor connected to operate said element to gradually reduce the flow of liquid from the pump prior to the operation of said element by the first motor.

17. The combination of two pipes; a pump; means for reversing the direction of flow of liquid propelled by said pump in said pipes; a motor mounted to be actuated by liquid flowing through said pipes; and means actuated by liquid under abnormal pressure in either of said pipes for operating said first-mentioned means.

18. The combination of a continuously operating pump; a motor connected to be driven by fluid propelled by said pump;

pressure actuated means for automatically reversing the direction of flow of fluid delivered by said pump, to periodically reverse the motor; with means for adjusting at will the rate of flow of fluid through the pipes.

19. In a stoker drive, the combination with a fluid motor having a fuel-feeding ram, said motor having a greater capacity for fluid when operated in one direction

than when operated in the other; of a valve responsive to the fluid pressure so operatively associated with said motor as to permit the escape of excess fluid when the motor is operated in one direction and to permit the supply of the deficiency when the motor is operated in the other direction.

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