Dec. 19, 1939. A. M. GURLEY ET AL 2,183,560

PUMPING SYSTEM

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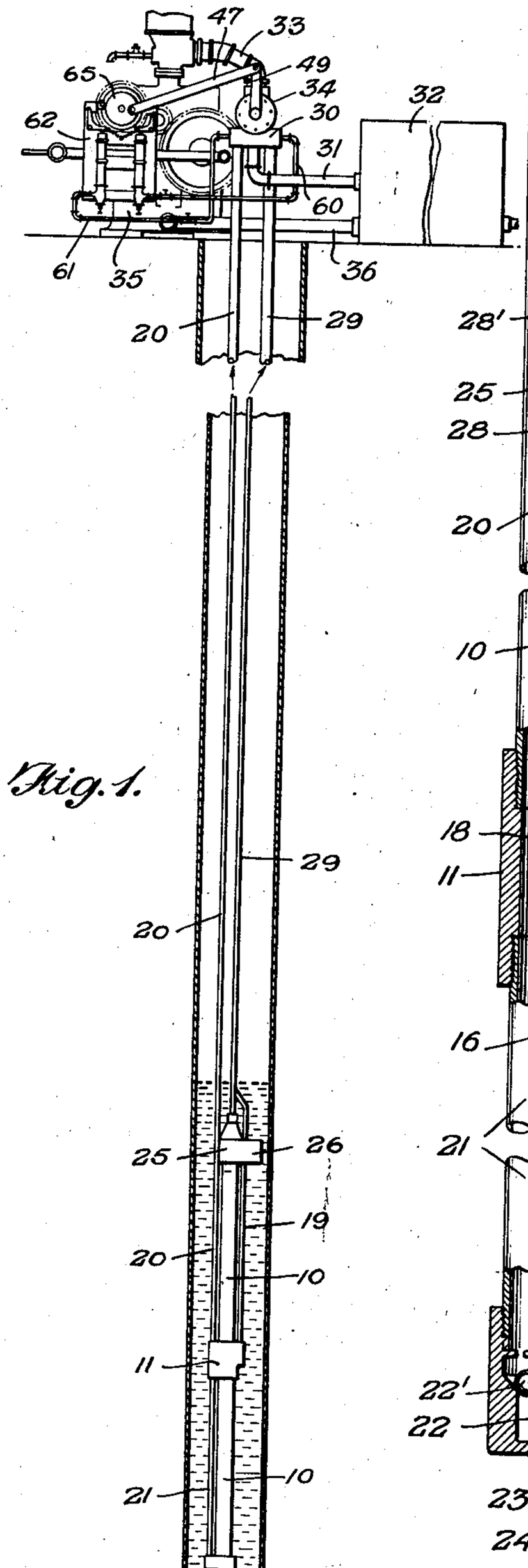

Fig. 1.

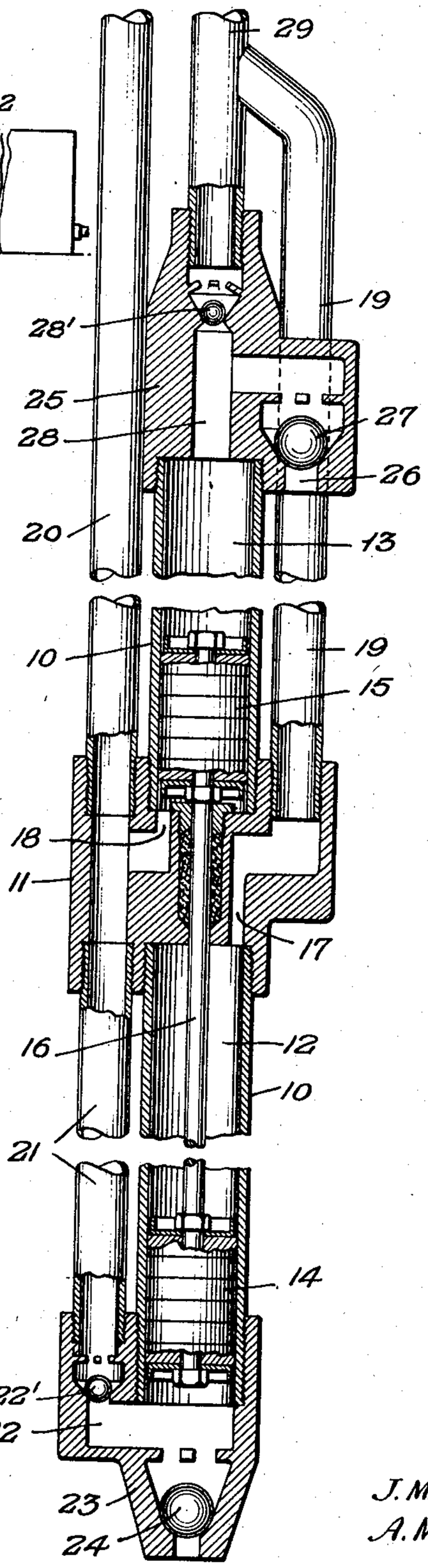

Fig. 2.

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Fig. 3.

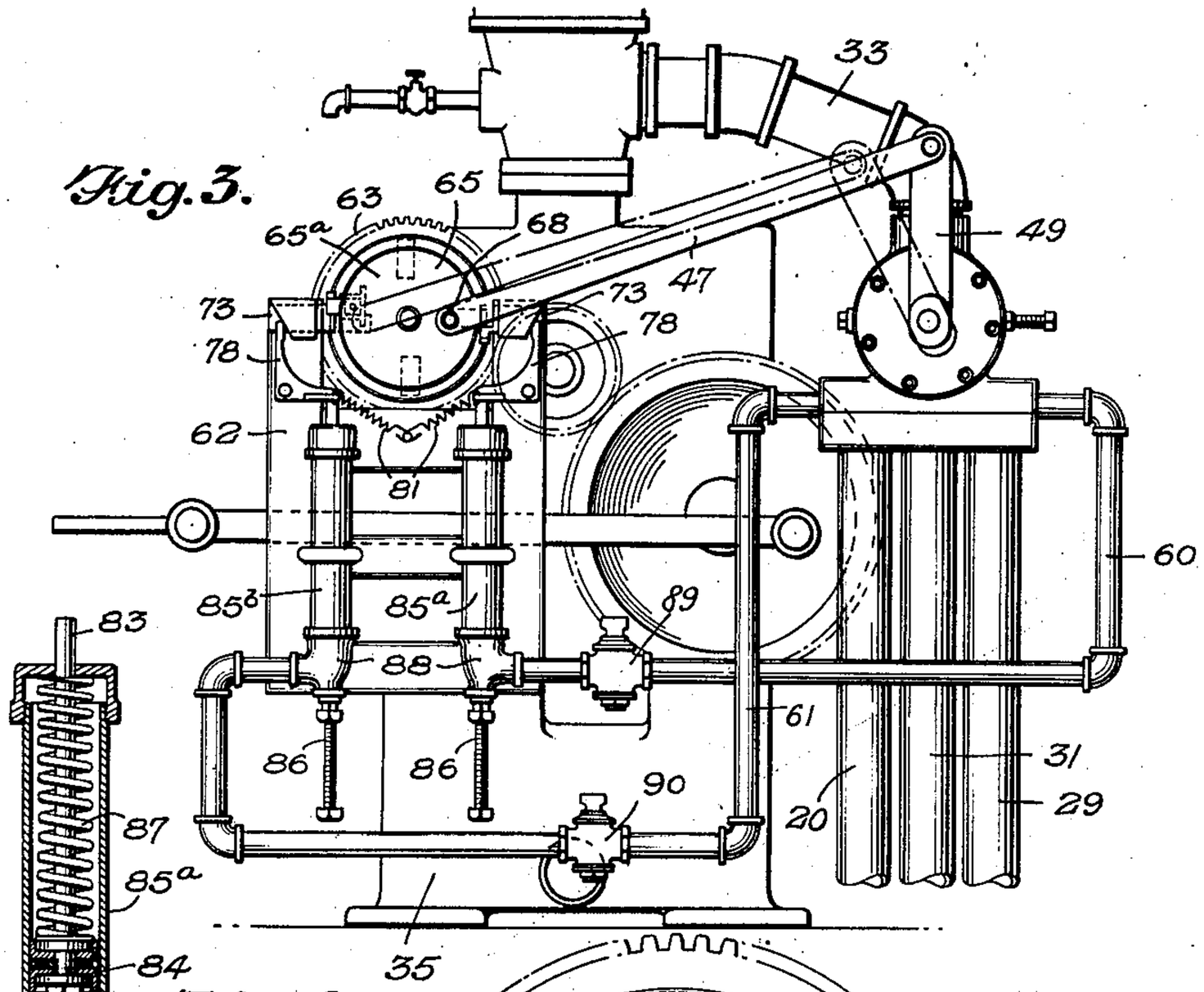

Fig. 6.

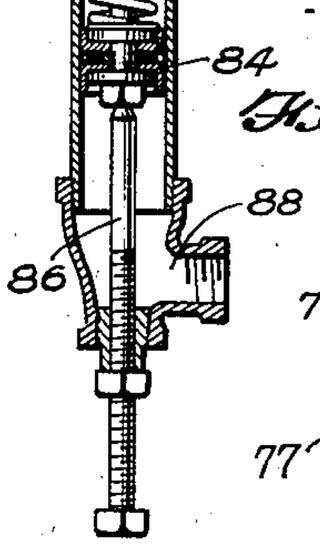

Fig. 4.

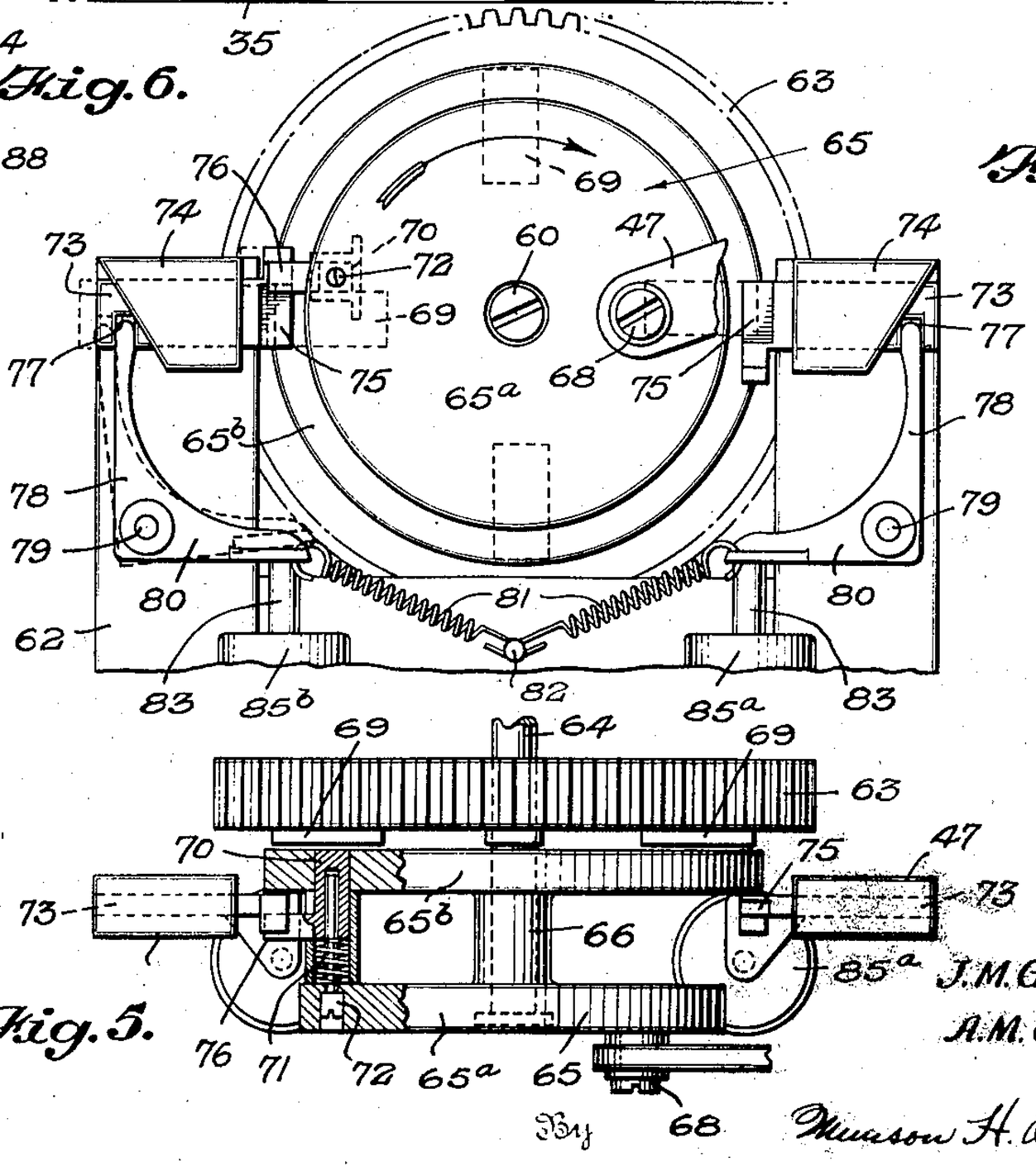

Fig. 5.

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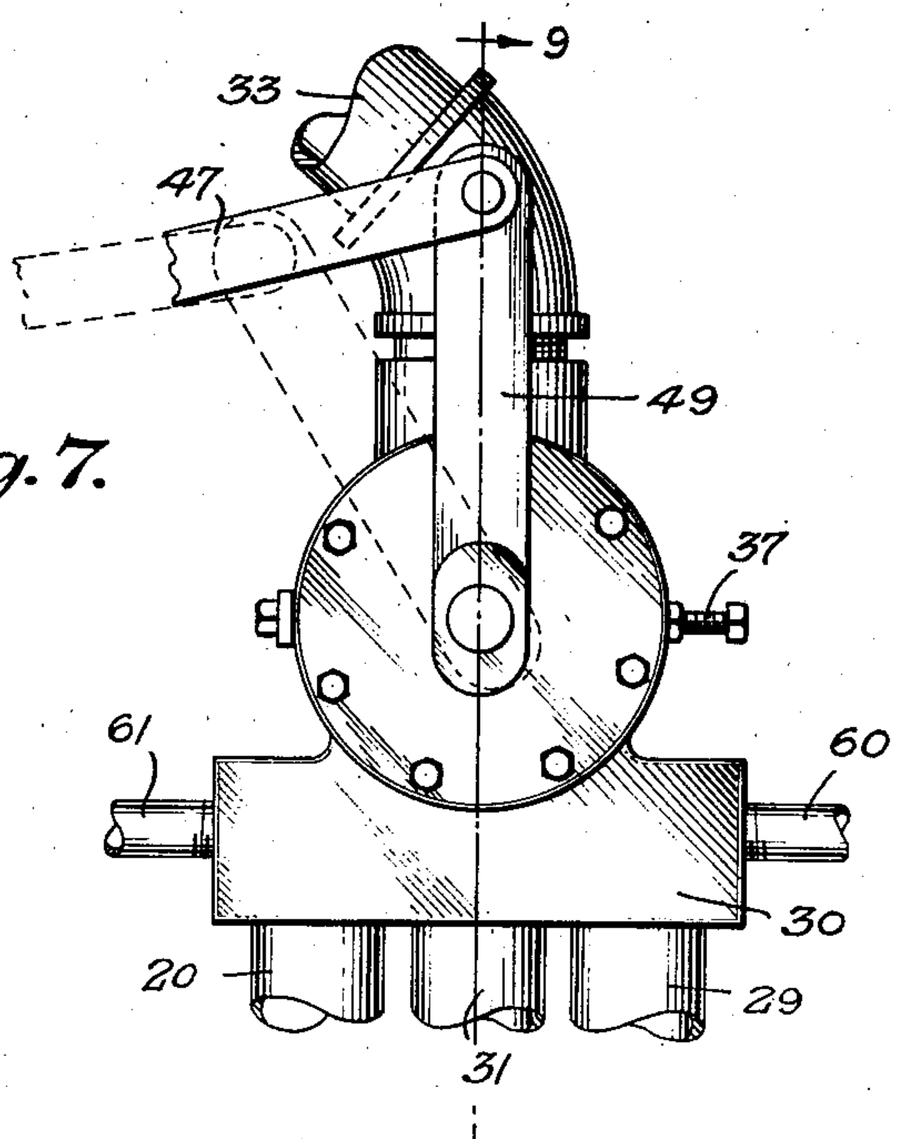

Fig. 7.

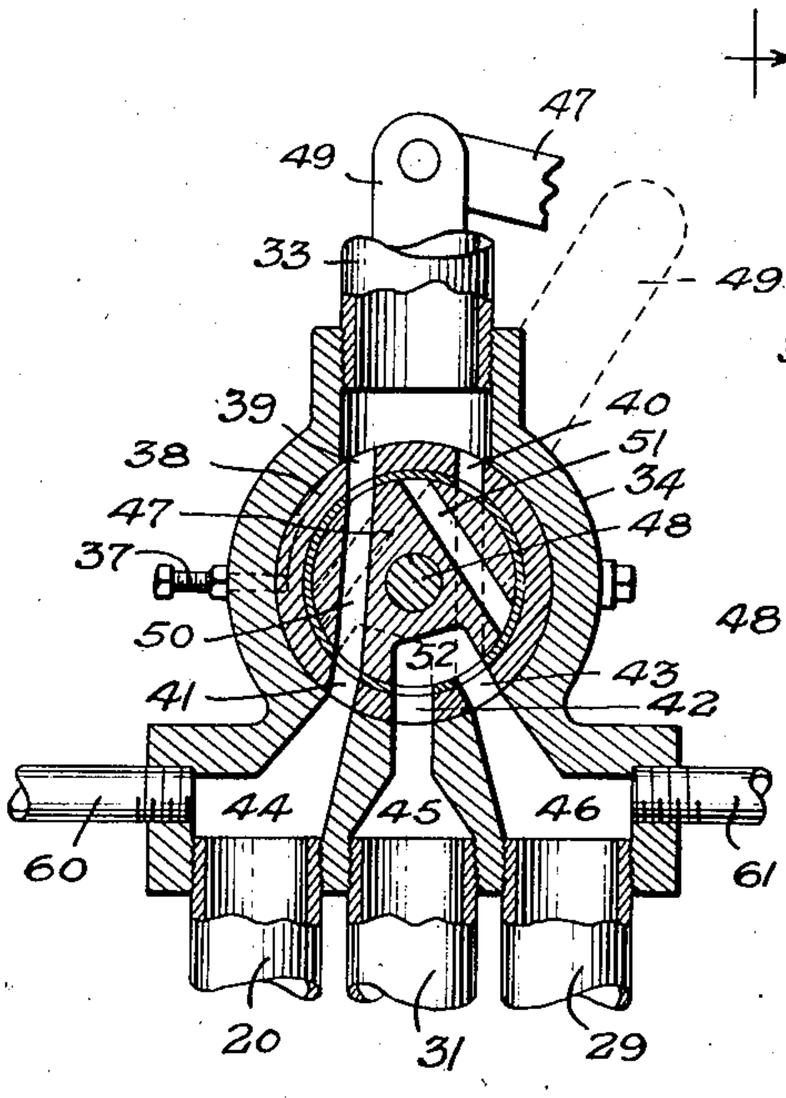

Fig. 8.

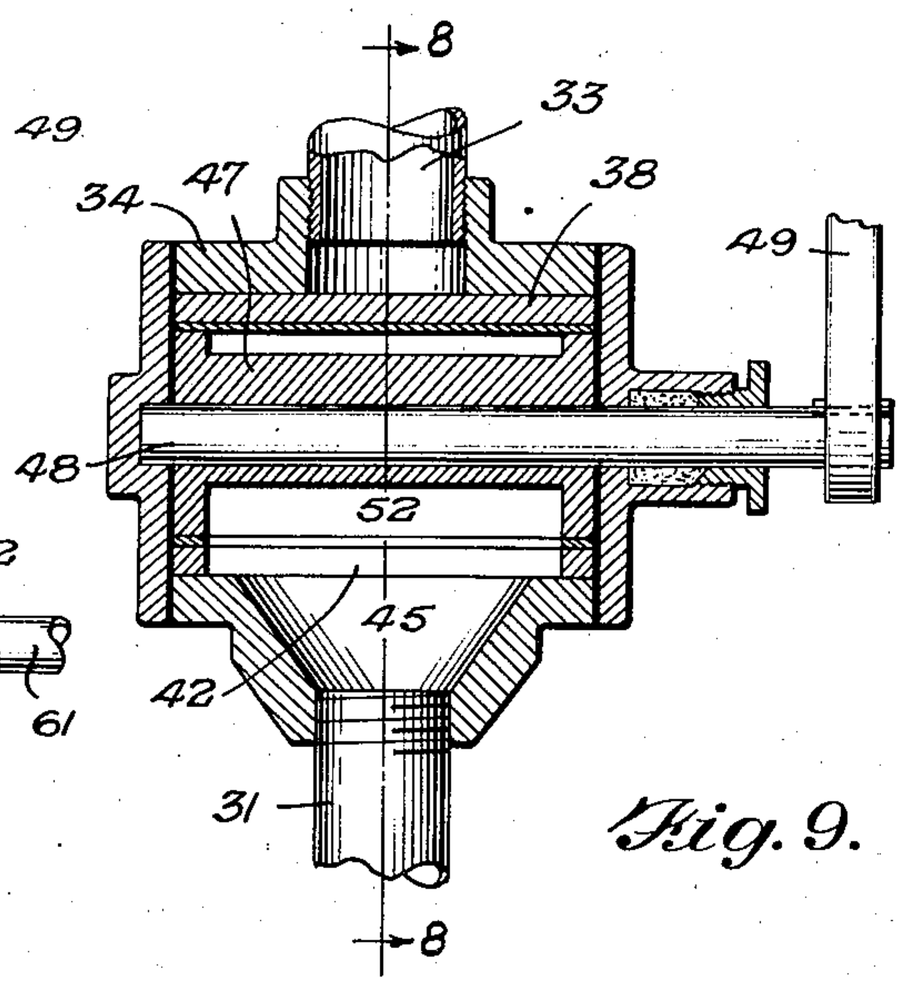

Fig. 9.

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Patented Dec. 19, 1939 2,183,560

UNITED STATES PATENT OFFICE

2,183,560

PUMPING SYSTEM

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Application April 7, 1938, Serial No. 200,763

4 Claims. (Cl. 103—44)

The invention relates to pumps for oil or water wells, the pump being of the type wherein the usual pump rod is eliminated, and a working barrel containing a double headed piston is employed near the bottom of the well which is operated by fluid pressure expended through one or the other of a pair of pipes communicating with said piston heads.

According to our invention we may employ the same liquid which is being pumped as the lifting medium. Also according to our invention we employ two vertical pipes extending into the well, through one of which pipes pressure fluid is applied to the piston while liquid is being elevated through the other. These two liquid columns largely balance each other so that the lifting strain is materially reduced. Valve means are provided for alternately directing the pressure fluid to one column or the other and means are employed actuated by the back pressure which accumulates at the end of each pumping stroke, for automatically shifting the control valve.

Our improvements reside in the pumping system as a whole, in the well pump per se, in the valve control mechanism and in the control valve, which latter details contribute to the efficiency of the system as a whole.

The invention will be more readily understood by reference to the accompanying drawings in which is illustratively set forth a specific embodiment of the inventive thought involved.

In the drawings:

Fig. 1 is an elevation somewhat diagrammatic in character illustrating the pumping system as a whole.

Fig. 2 is a view partly in elevation and partly in vertical section showing details of the well pump.

Fig. 3 is an elevation showing the pressure control system including the control valve and the automatic valve actuating means.

Fig. 4 is a detail elevation showing the valve actuating mechanism.

Fig. 5 is a top plan view of the same.

Fig. 6 is a detail vertical section showing one of the pressure cylinders forming part of the automatic control system.

Fig. 7 is a front elevation showing the fluid control valve and associated parts.

Fig. 8 is a vertical section on line 8—8 of Fig. 9.

Fig. 9 is a section on line 9—9 of Fig. 7.

Referring to the drawings in detail the reference numeral 10 denotes a pumping barrel generally cylindrical in shape which is lowered into a well containing liquid to be pumped, such as oil or water, the barrel being preferably wholly submerged in the liquid. The barrel is divided into two sections by means of a central casting 11 which separates a lower chamber 12 from an upper chamber 13, a piston head 14 working in the lower chamber and a second piston head 15 in the upper chamber, said heads being connected by a piston rod 16 which passes through suitable packing within the central casting.

The central casting 11 has a passage 17 communicating with the lower chamber 12 just above the piston 14 and a passage 18 communicating with the chamber 13 below the piston head 15 so that when fluid under pressure is applied through either of these passages the double headed piston will be driven in one direction or the other.

A pair of vertical pipes 19 and 20 are connected to the ports 17 and 18 respectively and through these pipes alternately fluid pressure will be supplied to the double headed piston or liquid forced out by said piston, according to the position of a control mechanism to be hereinafter described.

Below the casting 11 and in line with the pipe 20 is an extension pipe 21 similar to the pipe 20 leading to the bottom of the barrel 10 and communicating therewith below the piston head 14 through a passage 22 in a bottom casting member 23 into which both the barrel 10 and the pipe 21 are screwed. A check valve 24 is located within the bottom of the casting and is designed to admit liquid from the well but to prevent liquid being forced out at this point, and a check valve 22′ is located at the bottom of pipe 21 which permits fluid to flow upwardly while preventing downward flow into the passage 22.

At the upper end of the barrel 10 is a casting or head 25 having a suction pipe 26 communicating laterally therewith and provided with a suitable check valve 27 which permits liquid from the well to be drawn in but prevents liquid from flowing out. A central passage 28 through the casing 25 connects the upper chamber 13 with a pipe 29 leading upwardly to a control head 30 at the top of the well. A check valve 28′ is located at the bottom of the pipe permitting liquid to flow up but not down. As shown the pipe 19 joins the pipe 29 at some position prior to its connection to the control head 30. The pipe 20 also communicates with the control head 30 and a discharge pipe 31 is connected to the control head intermediate the two pipes 20 and 29, said discharge pipe leading to a suitable storage tank 32

having an outlet for withdrawing fluid therefrom.

Pressure fluid for operating the well pump may be delivered through a pipe 33 to a valve casing 34 shown as located at the top of the control head 30. The pressure fluid may be supplied by means of a pump 35 of any well known or desired type which may receive its fluid from the storage tank 32 through a connecting pipe 36.

Secured within the casing 34 by means of a set screw 37 is a hollow cylindrical sleeve member 38 having a pair of upper ports 39 and 40 communicating with the fluid pressure supply pipe 33 and three lower ports 41, 42 and 43 communicating with passages 44, 45 and 46 in the control head 30 which in turn communicate with the pipes 20, 31 and 29.

Rotatably mounted within the sleeve 38 is a valve plug 47, generally cylindrical in shape and fixedly carried upon a shaft 48 having its ends journaled in the ends of the casing 34 and provided with an operating lever 49 which is connected to suitable automatic actuating means to be hereinafter described, whereby the valve may be shifted at intervals to alternately connect and disconnect the pipes 20 and 29 to and from the source of fluid supply, the pipe which is disconnected from the fluid supply being at the same time connected to the discharge pipe 31 as clearly illustrated in Fig. 8.

As shown the valve 47 is provided with two passageways 50 and 51 extending therethrough and angularly arranged with reference to each other. Intermediate the passages 50 and 51 and at the periphery of the valve plug is a by-pass groove 52. In the position shown in Fig. 8 the passage 50 connects the ports 39 and 41 in the sleeve 38 and thus places the pipe 20 in communication with the source of pressure while the ends of the passage 51 abut against the solid portion of the sleeve 38 so that pipe 29 is cut off from the pressure fluid. In this position, however, the pipe 29 is connected to the pipe 31 so that the liquid being pumped up through the pipe 29 will flow through the passageway 46, by-pass 52, passage 45 and pipe 31 to the storage tank 32.

When the valve 47 is shifted through a suitable angle the ends of passage 51 will be in registry with the ports 40 and 43 thus placing the pipe 29 in communication with the pressure supply while the pipe 20 is cut off from said pressure supply but is placed in communication with the discharge pipe 31.

The operation of those parts of the apparatus which have been described will now be briefly reviewed. Assuming the valve in the position shown in Fig. 8, pressure is supplied through pipe 20 and passage 18 to the under portion of the piston head 15. Pressure fluid also passes down the pipe 21 but is prevented from entering the casting 23 by the check-valve 22'. The double headed piston is forced upwardly by means of the fluid beneath the piston head 15 and any liquid which may be in the chambers 12 and 13 and in the pipes 19 and 29 is raised by the rising piston head. Any excess liquid passes through the by-pass connection 52 into discharge pipe 31 and thence to the storage tank 32.

The upward movement of the piston head 15 also raises the piston head 14 thus drawing liquid from the well into the bottom of the barrel past the check valve 24, filling that portion of the barrel below the piston 14. At the end of the piston stroke the control valve plug 47 will be shifted through the proper angle and the pressure fluid supply will then be placed in communication with the pipe 29, while the pipe 20 is cut off. The liquid passes down pipe 29 and the branch pipe 19, entrance of the pressure fluid into chamber 13 above the piston 15 being prevented by check valve 28' while the fluid passing down the pipe 19 and through passage 17 in the central casting 11 urges the piston 14 downwardly together with the piston head 15 connected thereto, liquid being thereby forced upwardly through pipes 21 and 20 to the control head and thence out through the discharge pipe 31 while liquid is drawn into the chamber 13 through the suction pipe 26. As the position of the control valve is intermittently shifted the alternation of the pump cycles through pipes 19 and 20 continues as above described.

I have provided improved means for automatically shifting the control valve at the end of the piston stroke by means of the back pressure built up at the end of such stroke. As shown in Figs. 1, 3, 7 and 8 a pair of pipes 60 and 61 extend from opposite ends of the pressure head 30, the pipe 60 communicating with the chamber 44 above the pipe 20 and the pipe 61 communicating with the chamber 46 above the pipe 29. As will be apparent at the end of each plunger stroke within the pumping barrel, back pressure is developed and such pressure will be transmitted through one or the other of said pipes 60 or 61. This back pressure is utilized for automatically operating valve actuating means now to be described.

The automatic valve actuating means is shown as mounted upon a suitable frame, stand or support 62 located in the vicinity of the fluid control valve and pressure head 30. A wheel 63 for furnishing the power is shown as rotatably mounted upon a fixed shaft 64 carried by the pump 35. The wheel 63 is adapted to be continuously rotated from any suitable source of power as for example the motor (not shown) which actuates the pump 35. The power wheel is adapted to intermittently drive a valve control wheel 65 through suitable clutch mechanism which is thrown in and out at intervals. The control wheel 65 is herein shown as in the form of a spool and comprising two disks 65*a* and 65*b* connected by a hub 66 rotatable upon the shaft 64 upon which the power wheel is likewise mounted. The valve control wheel 65 is connected to the valve arm 49 by means of a connecting rod 67 which is attached to the outer face of disk 65*a* through an eccentrically mounted pin 68. By this means any rotation of the wheel 65 will be imparted to the control valve plug 47.

Means are provided for automatically connecting or clutching the valve control wheel 65 to the continuously rotating wheel 63 at the end of each stroke of the double headed plunger within the pumping barrel, the engagement between the two wheels continuing for an interval sufficient to change the position of the control valve, after which the valve control wheel 65 is released from the driving wheel until the time comes for again shifting the control valve.

As shown lugs 69 (four in number) are secured at 90° intervals upon the face of the drive wheel 63 adjacent the disk 65*b*. These lugs are adapted to be engaged by a lug or plunger 70 carried by the control wheel 65 to lock the two wheels together. The plunger is shown as extending through an aperture in the disk 65*b* and a spring

71 mounted about a guide pin 72 reacts between the inner face of disk 65*a* and the top of the lug 70 to constantly urge the member 70 toward the face of the driving wheel 63. Said lug 70 however is normally retracted by means of one or the other of a pair of slidable members 73, 73 carried in fixed guide members 74, 74 supported by the frame at opposite sides of the control wheel 65. The inner end of each of said slidable members is beveled as indicated at 75 so as to form a cam surface. It will be noted that the cam surfaces of the two members 73 are oppositely inclined. A finger 76 carried by the lug 70 normally rests upon the highest portion of the inclined surface 75, thus holding the plunger lug 70 out of engagement with the lugs 69 on the wheel 63.

Each of the sliding members 73 is provided with a notch 77 which is engaged by one arm 78 of a bell crank member pivotally mounted upon the frame at 79, the other end 80 of each bell crank being connected to one of a pair of springs 81, 81 secured to the frame at 82. The arms 80, 80 of the bell crank members are normally held in horizontal position and rest upon push rods 83, 83. In this position the arms 78, 78 of the bell crank members are vertical and the slide rods 73, 73 are in such position that their inner ends will be in the path of the extension finger 76 of the lug 70. Each push rod 83 is provided with a plunger 84 which includes a plurality of washers so as to establish a fluid tight connection with the interior of the cylinder within which the plunger works. Two such cylinders 85*a* and 85*b* are provided one beneath each of the bell crank members. The normal position of the push rod 83 is maintained by contact with the head of an adjusting bolt 86 which passes threadedly through the lower portion of the cylinder in which it is mounted. A strong coil spring 87 presses the plunger 84 into contact with the head of the adjusting rod. Each cylinder is provided with a nipple 88 through which fluid under pressure may be supplied for operating the plunger 84 and push rod 83. As shown the pressure line 60 is connected to the base of the cylinder 85*a* and the pressure line 61 is connected to the base of the cylinder 85*b*. Suitable control valves 89 and 90 may be provided within the pressure lines 60 and 61.

It is believed that the operation of the device will be apparent from the foregoing description but for the purpose of clarity it will now be summarized.

When back pressure is developed within the piston head 30 at the end of the piston stroke within the pumping barrel 10 at the bottom of the well, such pressure will be transmitted through line 60 or 61 to one of the cylinders 85*a* or 85*b*. This pressure forces up one of the plungers 84 against tension of spring 87 thus raising the push rod 83 and causing it to engage the arm 80 of the bell crank 11 and causing the other arm 78 of the bell crank lever to move outwardly drawing with it the slide member 73 sufficiently so that its inner end will pass from beneath the finger 76, whereupon the spring 71 urges the plunger lug 70 into the path of the lugs 79 on the wheel 63. Thereupon the two wheels 65 and 63 are temporarily clutched together and rotate in unison for a short period. The rotation of the valve control wheel 65 is transmitted through connecting rod 67 to the arm 49, and thence to the valve plug 47. As soon as the valve has rotated sufficiently to cut off contact between the flow line 33 and the pipe 20 back pressure ceases to be transmitted through the pipe 60 to the cylinder 85*a* and the push rod 83 is returned to its normal position by the spring 87 thus moving the slide 73 to its normal positon. Meantime the control wheel 65 continues to rotate with the wheel 63 until the finger 76 carried by the wheel 65 reaches the cam surface 75 of the slide rod on the opposite side from the one with which it was previously engaged, this cam surface being in the path of the finger 76, said finger rides upon the cam surface until it is stopped by a projection at the upper limit of said surface.

This operation of course withdraws the lug or plunger 70 from clutching engagement with the lugs 69 whereupon the wheels 65 and 63 are disengaged, the wheel 65 being held stationary and the wheel 63 continuing its rotation. When the parts have reached this position the plug of the pressure control valve will have rotated to such a position that pressure fluid from the supply pipe 33 will now be supplied to the other of the two pipes 20 or 29. Assuming that the pressure fluid is supplied to the pipe 29 the double plunger within the pumping barrel 10 will move to the end of its stroke, whereupon back pressure will be built up within the chamber 46 in the pressure head 30 and transmitted through the pipe 61 to the cylinder 85*b* thus retracting the other slide rod 73 and releasing the movable lug or plunger 70 so that it will engage the lugs 69 on the rotatable wheel 63 and cause a further rotation of the control valve. This process continues intermittently and automatically as long as the power wheel 63 continues to rotate.

The invention has been described in detail for the purpose of illustration but it will be apparent that many variations and modifications may be resorted to without departing from the spirit of the invention.

We claim:

1. In a pumping system of the type wherein a fluid pressure pump of the reciprocating plunger type is provided with two lines leading thereto and adapted to alternately supply pressure fluid to said pump and withdraw fluid which has been acted on by the pump plunger, and valve means are provided for alternately connecting one of said pipes to a source of pressure and the other to a discharge line; means, for shifting the valve at the end of each stroke of the pump plunger, automatically initiated by the back pressure developed at the end of the plunger stroke, said means comprising a continuously rotating power wheel, a valve control wheel having a pitman connecting the same to said valve for rotating the same, and means actuated by the back pressure built up in one or the other of said pump lines at the end of each plunger stroke for automatically connecting said valve control wheel to said power wheel, and mechanical means for disengaging the valve control wheel when the valve has reached the position to permit pressure fluid to be supplied to the second of the pump lines.

2. A control mechanism as set forth in claim 1, wherein a spring pressed plunger carried by the valve control wheel is automatically released to engage a lug on the power wheel when back pressure is built up in one of said pump lines, and is again retracted when the valve has moved to the position to supply pressure to the other line.

3. For use in a pumping system of the type

wherein a fluid pressure pump of the reciprocating plunger type is provided with two lines leading thereto and adapted to alternately supply pressure fluid to said pump and withdraw fluid which has been acted on by the pump plunger, and rotatable valve means are provided for alternately connecting one of said pipes to a source of pressure and the other to a discharge line; control mechanism for shifting the valve at the end of each stroke of the pump plunger, automatically initiated by the back pressure developed at the end of the plunger stroke, said control mechanism comprising a continuously rotating driving member, a driven valve actuating member, means actuated by the back pressure built up in one or the other of said pump lines at the end of each plunger stroke for automatically clutching said valve actuating member to said driving member, and mechanical means for disengaging the valve control member from the driving member when the valve has reached the position to permit pressure fluid to be supplied to the second of the pump lines.

4. For use in a pumping system of the type wherein a fluid pressure pump of the reciprocating plunger type is provided with two lines leading thereto and adapted to alternately supply pressure fluid to said pump and withdraw fluid which has been acted on by the pump plunger, and rotatable valve means are provided for alternately connecting one of said pipes to a source of pressure and the other to a discharge line; control mechanism for shifting the valve at the end of each stroke of the pump plunger, automatically initiated by the back pressure developed at the end of the plunger stroke, said control mechanism comprising a continuously rotating driving member, a driven valve actuating member, said driving and driven members being provided the one with a plurality of spaced lugs, and the other with a normally retracted spring-pressed finger adapted when released to be projected into the path of said lugs, means adapted to be actuated by back pressure built up in one or the other of said pump lines at the end of each plunger stroke for releasing said spring-pressed finger, whereby said driven member is momentarily clutched to the driving member for actuating said valve, and means for retracting said finger when the valve has been actuated.

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