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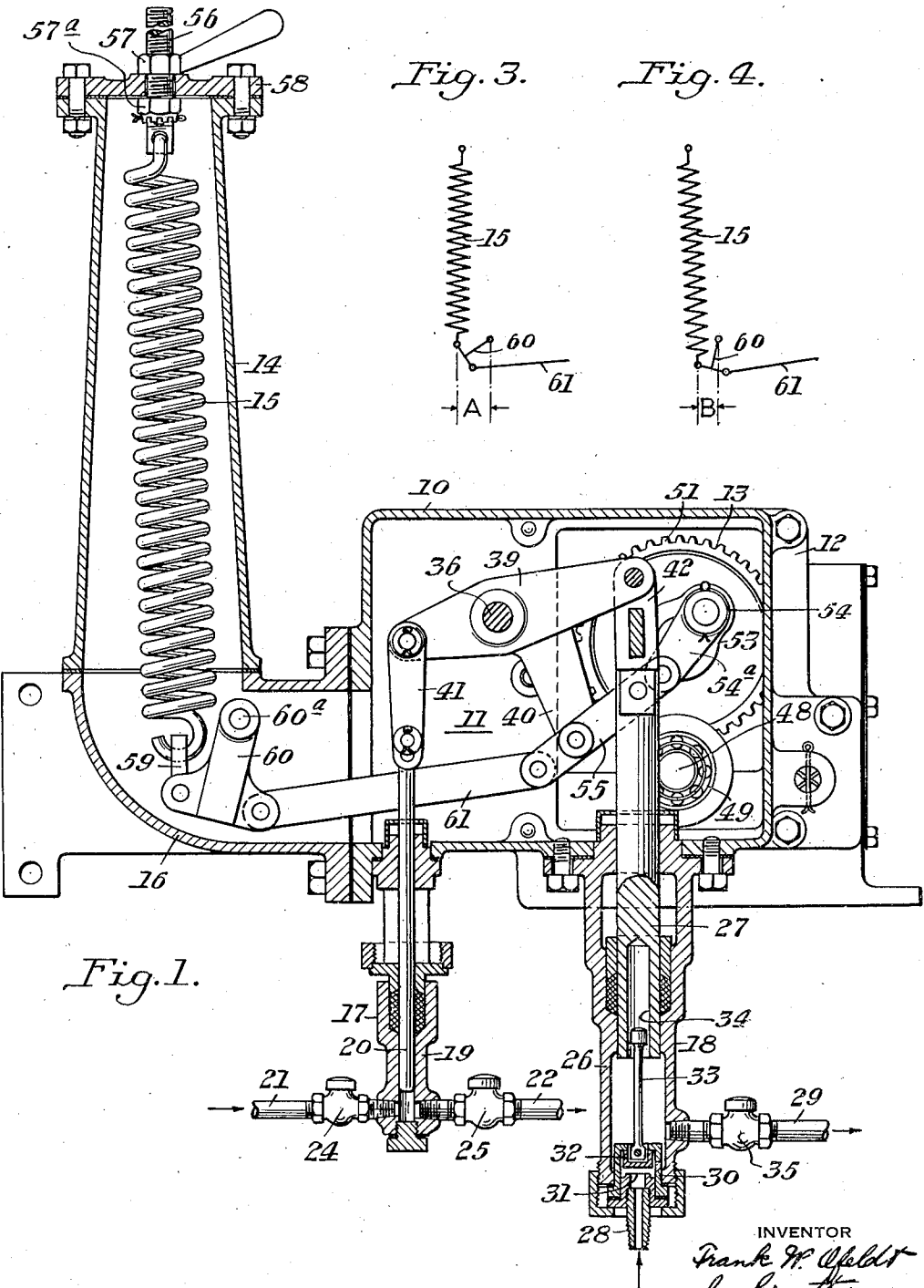
F. W. OFELDT

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FLUID HANDLING DEVICE

Filed Aug. 1, 1930

2 Sheets-Sheet 1



INVENTOR  
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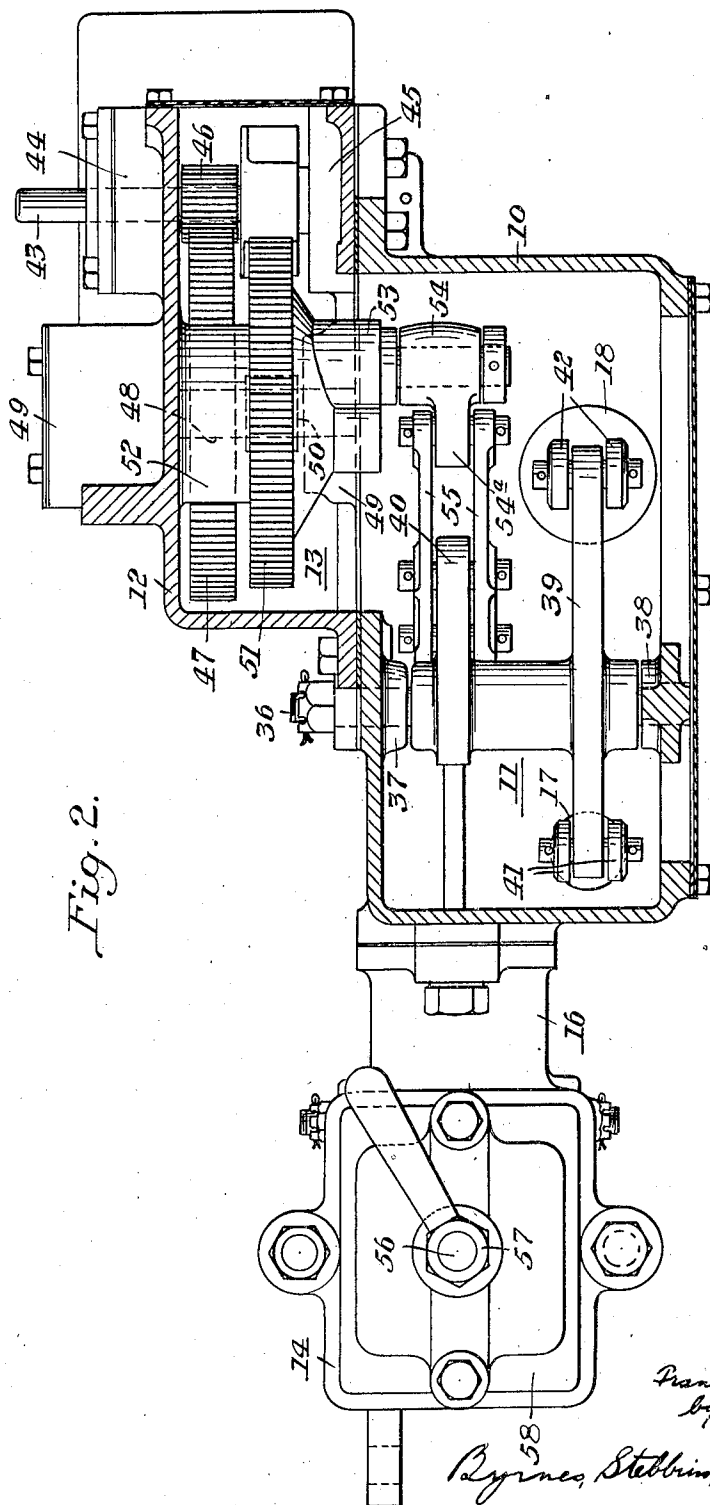
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## UNITED STATES PATENT OFFICE

1,925,457

## FLUID HANDLING DEVICE

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Application August 1, 1930. Serial No. 472,298

6 Claims. (Cl. 103—211)

My invention relates to a pump for supplying fuel and water to a portable water heater of the type described in my copending applications, Serial Nos. 215,557 and 221,455.

5 The copending applications disclose types of pumps for supplying fuel and feed water, and the present invention is an improvement on the construction in application Serial No. 215,557. As  
10 disclosed in said application, I have previously employed fuel and feed water pumps of a reciprocating type which were actuated by a spring connected to a rocking lever to which the pistons of the pumps were connected. A motor drive for the  
15 lever was provided, including a loose connection whereby the compression stroke of the pumps was caused solely by the tension set up in the spring by reason of the movement of the drive mechanism. As a result of this construction, the operation of the fuel and feed water pumps depends  
20 on the adjustment of the spring and on the back pressure against which the pumps operate. The fuel pump feeds an open burner and, therefore, does not operate against much pressure, but the feed water pump supplies water to a heating coil  
25 under considerable pressure, so that the back pressure on the feed water pump is the principal controlling factor in the operation of the system.

In the pump mechanism described in the copending application, the actuating spring is directly connected to the rocking lever at right angles thereto, so that the spring works through a substantially constant lever arm, the angular movement of the operating lever of the pumps being small. For a low back pressure, the water pump executes substantially a complete compression stroke on each rotation of the drive mechanism. If the back pressure is considerable, on the contrary, the actuating spring will not be strong enough to force the piston of the water pump  
40 through a complete compression stroke.

With such an arrangement, the actuating spring may not be effective to cause a full stroke of the feed water pump, even though the spring is initially effective to actuate the pump against  
45 the pressure in the heating coil. Obviously, the effectiveness of the spring decreases with the movement of the pump piston on its compression stroke, and the result is that only a small amount of feed water is supplied to the heating coil, even though the pressure in the latter is less than normal. With the feed water pump operating as described, the output of the heating coil is limited. Maximum output is not obtained unless the pressure in the heating coil drops considerably below

the normal value at which operation of the feed water pump is arrested.

In present pump operating mechanisms, therefore, the stroke of the pump is substantially inversely proportional to the back pressure. The stroke is a maximum when the pressure is a minimum and the stroke decreases as the pressure increases through the operating range to the point of cut-off where the back pressure is such that all pump operation is precluded. The capacity of the pump which is measured by the product of the back pressure times the stroke is, therefore, quite limited throughout the operating range because one of these factors has a comparatively low value at all times.

Similarly, if the device is adjusted to operate at full capacity at high pressure, and the outlet of the heating coil closed, the pump would continue to supply water until the pressure in the coil was raised considerably above that at which the pump should normally stop. This is due to the fact that when the actuating spring is stressed to the point of maximum effectiveness, it will actuate the pump through a part of the stroke to supply feed water, even though the pressure in the coil is sufficient to prevent a full stroke of the pump. There is thus a wide difference between the pressures at which the pump operates at full capacity and stops. At intermediate pressures, the pump operates at less than full capacity and the system output is thereby limited. In the previous devices, therefore, it is impossible to obtain maximum output with a slight drop in coil pressure and excess coil pressures are developed before the pump ceases operation. Such excess pressures set up strains in the coil and cause the safety valve to blow, all of which is undesirable.

The foregoing difficulties are overcome by the present invention. I have invented means for causing the actuating spring to increase in effectiveness as the pump effects its compression stroke. The actuating spring is thus most effective at the end of its stroke, so that any stroke started will be completed. At the same time, the effectiveness of the spring at the beginning of the stroke is a minimum, so that if the coil pressure is above a predetermined value, the pump will not start. The pump thus makes a full compression stroke or fails to start, depending on whether the coil pressure is less or greater than the spring tension at the beginning of the stroke.

The force exerted by the spring of course, increases with its extension. The invention provides means whereby the application of a spring force to the pump is varied so that the speed of

pump operation is varied. As the back pressure increases, the speed of the pump decreases very rapidly and the stroke likewise is sharply reduced with increases in the back pressure.

5 With this device, it is possible to obtain a very close regulation of the system so that full capacity of the pump may be taken advantage of, very close to the point at which operation automatically ceases. Only a slight drop in pressure is  
10 necessary to cause the pump again to start operating at full capacity. These results are essential to the correct operation of the device since they permit full capacity to be obtained throughout the working period, regardless of the coil pressure, and yet cause the pump operation to cease  
15 precisely at the selected pressure. The invention also prevents surging or hunting of the pressure of the system.

In accordance with the invention, I connect  
20 the pistons of the fuel and water pumps to opposite ends of a walking beam. The beam is actuated in one direction by a motor driven crank which has a buckle link connection to the walking beam. The beam is actuated in the opposite  
25 direction by a spring which is connected to the beam through a linkage including a bell crank so arranged that the lever arm through which the spring is effective varies with the position of the beam. The spring works through a minimum  
30 lever arm at the commencement of the compression stroke of the water pump and through a maximum lever arm at the end of such stroke. The buckle links and spring connections are designed so that when the spring is effective to  
35 actuate the pump, the links will not be straightened out. The shock resulting from the picking up of the spring tension by the motor driven crank is thus minimized by the straightening of the links. The water pump inlet valve is designed  
40 so that it will be operated regardless of whether the piston of the pump makes a complete stroke or a partial stroke only.

For a complete understanding of the invention, reference is made to the accompanying drawings, in which

Figure 1 is a longitudinal sectional view showing the operating mechanism in elevation;

Figure 2 is a transverse sectional view showing a portion of the mechanism in plan; and

50 Figures 3 and 4 are diagrammatic views illustrating the principle underlying the operation of the device.

Referring in detail to the drawings, the invention comprises a main housing 10 enclosing the drive mechanism 11, an auxiliary housing 12 secured to the main housing for enclosing a reducing gear 13, a housing 14 enclosing an actuating spring 15, and an elbow 16 connecting the spring housing 14 to the main housing  
60 10 and providing a bearing for a portion of the operating mechanism, as will be described later.

A fuel pump 17 and a feed water pump 18 are fitted to the bottom of the housing 10. The fuel pump 17 comprises a cylinder 19 and a piston 20. Inlet and discharge conduits 21 and 22 are connected to the pump cylinder through check valves 24 and 25. The feed water pump 18 comprises a cylinder 26 and a piston 27. Inlet and discharge conduits 28 and 29 are connected to the cylinder 26. A perforated sleeve 30 is disposed over the end of the inlet conduit 28, and a valve seat 31 is located therein for a valve disc 32. The disc 32 is connected to a valve stem 33, the upper end of which is enlarged and fits within a bore 34 in the piston 27.  
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A check valve 35 is located in the discharge conduit 29 and leads to the heating coil. The conduit 22 leads to the burner, and the conduits 21 and 28 are connected to suitable sources of fuel and water.

A shaft 36 is journaled in the housing 10 in bearings 37 and 38 formed therein. A walking-beam 39, having a crank arm 40, is rotatably mounted on the shaft. A link 41 connects one end of the beam 39 to the piston 20 of the fuel  
85 pump 17. A similar link 42 connects the other end of the beam 29 to the piston 27 of the feed water pump 18. It will now be apparent that the fuel and feed water pumps may be operated by oscillating the beam 39 through a medium  
90 such as the arm 40.

The pumps may be driven by any type of primary mover such as an internal combustion engine or an electric motor. Because of the possible variations in the driving mechanism, I have not illustrated any particular type but, in any case, the prime mover is coupled to a drive shaft 43 journaled in bearings 44 and 45 formed integrally with the wall of the housing 12. A pinion 46 is keyed to the drive shaft 43 and meshes with a gear 47 keyed to a shaft 48. The shaft 48 is supported in bearings 49 and carries a pinion 50. The pinion 50 meshes with a gear 51 which rotates on a shaft supported in a bearing 52. A crank 53 integral with the gear 51 carries a sleeve 54 having an arm 54a pivoted to a double link 55. The link 55 is also pivoted, at a point to one side of the center of its length, to the crank arm 40 which is integral with the beam 39.  
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It will be perceived that the mechanism already described, when operated, will be effective for moving the beam 39 to the position shown in Figure 1. Because of the hinged connection between the crank 53 and the arm 40 constituted by the sleeve 54 and the links 55, however, the driving mechanism will not be effective to cause a reverse movement of the beam 39. In order to return the pump mechanism, the spring 15 is provided. The spring 15 is secured at its upper end to a stud 56 which is adjustably supported by an adjusting nut 57 on a cover 58 bolted to the top of the housing 14. A nut 57a on the stud limits the range of adjustment. The lower end of the spring 15 is secured to a link 59 which is pivoted to a lever arm 60 journaled on a pin 60a projecting from the elbow 16. The lever 60 is connected to the links 55 by a link 61 which is pivoted to both of the aforementioned parts. By means of the connections just described, the spring 15 serves to actuate the pumps in one direction after the driving mechanism 13 has shifted them to the limit of movement in the other direction.  
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The effectiveness of the spring 15, in causing a compression stroke of the feed water pump 18, of course, depends on the tension in the spring 15 and the moment arm through which it operates. The lever 60 provides means for varying the moment arm through which the spring acts, and the adjusting stud 56 and the nuts 57 provide means for changing the tension in the spring. As will clearly appear from Figures 3 and 4, the effectiveness of the spring varies with the position of the lever 60. When the lever has the position shown in Figure 3, the spring operates on the pump through the link 61 on a moment arm A. When the lever takes up the position shown in Figure 4, it will be apparent that it is effective only through a moment arm B.  
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If the spring tension is sufficient to start the pump piston, therefore, a complete stroke thereof is insured by the increasing effectiveness of the actuating spring. The lever 60 obviously must be dimensioned and positioned so that the increase in the effectiveness of the spring resulting from movement of the lever is greater than the decrease in the effectiveness of the spring resulting from the contraction thereof. It is easy to arrange the lever 60 so that the effort exerted therethrough by the spring will be increased as the spring contracts, in spite of the lowered tension in the spring resulting from the contraction thereof. The capacity of the system is thus not limited when only a slight pressure drop occurs in the coil. When the coil pressure builds up, the fact that the effectiveness of the spring is a minimum at the commencement of the compression stroke, prevents any movement of the piston if the back pressure has the required value. The coil pressure at which the pump stops is thus very little above that at which capacity operation is resumed.

The operation of the device will first be described, assuming that the pressure of the water in the heating coil is being relieved at the far end thereof so that the back pressure against the pump 18 is low enough to permit the spring to start the pump piston. With the apparatus in the position shown in Figure 1 and the crank 53 rotating in a clockwise direction, it will be apparent that the spring 15 will tend to swing the lever 60 lockwise and so turn the beam 39 in the same direction through the links 61, 55 and the crank arm 40. With the lever in the position shown, corresponding to that of Figure 4, the spring is effective through only a comparatively short moment arm. If the back pressure on the pump 18 is slightly above the starting value, however, the spring 15 will not be effective to swing the lever. Assuming the required slight drop in pressure, the beam moves and, as the movement progresses, the moment arm of the spring on the lever 60 increases. The spring thus becomes increasingly effective to force the piston of the pump 18 into the cylinder. As previously stated, the increase in the effectiveness of the spring brought about by the shifting of the lever 60 must be greater than the decrease in the spring force resulting from the contraction of the spring so that the net result will be an increase in the effort exerted by the spring through the lever. As the piston 27 descends, the valve stem 33 forces the valve disc 32 against the valve port 31. There is a slight loss of motion between the piston and the valve stem, but the water accumulating in the bore 34 serves to force the valve shut shortly after the piston has started down. As the piston moves down, the check valve 35 opens and the pump forces the water trapped in the cylinder into the conduit 29 and thence to the heating coil. At the same time, the piston 20 of the fuel pump 17 moves upward to execute a suction stroke. The valve 25 closes and the valve 24 opens to permit fuel to flow into the cylinder 19.

The construction of the valve 32 insures its operation even when the piston executes only a partial stroke.

The compression stroke of the pump 18, of course, is not completed until the crank 53 rotates substantially 180° from the position shown in Figure 1. After the crank passes this point, however, it becomes effective through the links 55, which are now in tension, to reverse the

movement of the beam 39. The broken connection between the crank and the beam prevents any operation of the latter by compression of the pivoted connecting links. The crank picks up the spring load through the links 55 and 61 and the lever 60. These elements form a connection having a little lost motion. The spring load is thus gradually assumed by the crank with a minimum of shock and noise. As the movement of the crank continues, the fuel pump 17 executes a compression stroke and the pump 18 a suction stroke. The only simultaneous valve operation which may require description is that of the valve mechanism 30, 31, 32. As the piston 27 rises, the pin 33 is drawn upwardly therewith until the disc 32 moves off the port 31 for admitting water to the cylinder 26 through the perforations in the sleeve 30. When the disc 32 engages the top flange of the sleeve 30, further movement of the stem 33 is prevented, and the continued movement of the piston fills the cylinders preparatory to a compression stroke. The return movement of the beam 39 is, of course, accompanied by an extension of the spring 15 so that, when the crank 53 reaches the position shown in Figure 1 and passes on, the spring is prepared to cause another compression stroke of the pump 18.

The prior art devices operate on a substantially straight line relation between the back pressure and the pump stroke, the stroke being inversely proportional to the back pressure. The present invention varies this linear relation so that the pump operates at full stroke for a greater range of operating pressures whereby greater capacity is obtained. When the back pressure approaches very closely to the cut-off value, the stroke of the pump is cut down sharply until cut-off is reached. This result is accomplished by superimposing upon the old direct action spring in which the force exerted on the pump varied inversely with the pump stroke, means for varying the angle of application of the spring force to the pump operating mechanism whereby the linear relation is replaced by a non-linear relation with the result that full stroke pump operation over a wider range of operating pressures can be attained.

Even though the bell crank 60 is employed to compensate the action of the spring as described hereinabove, the piston 27 of the feed water pump will have a slight movement during periods when the heating coil is idling. This movement is due to the fact that a certain time is required for the spring to start the pump piston and this time is sufficient to permit the crank 54 to make a complete revolution before the pump is moved very far and thus to limit the movement thereof on its compression stroke.

From the foregoing description, it will be seen that I have provided a spring actuated pump in which the actuating spring is rendered more or less effective, depending upon the extension thereof. When the heating-coil pressure is above the operating value, the pump stops when the spring reaches the point of minimum effectiveness. When the pressure drops slightly, the pump executes a full compression stroke because the spring, once started, increases its effectiveness.

The output of the heating coil is not limited by a partial ineffectiveness of the pump when the coil pressure is only slightly under the idling value. Prompt shut off results when the pressure exceeds such value, and a close regulation is obtained. The zone between full operation and

complete shutoff is narrow and partial pump operation occurs only in this narrow zone. Even when idling, therefore, a small amount of water is supplied to compensate inevitable losses. The operating linkage is designed to reduce shock and the valve to insure proper operation thereof even within the zone of partial pump operation.

Although I have illustrated and described but a single present preferred embodiment of the invention, it is obvious that the construction thereof may be varied in any detail. Such changes may be made, however, without departing from the spirit of the invention as set forth in the following claims.

I claim:

1. The combination with a reciprocating feed water pump working against a pressure head, and a motor and spring for actuating the pump on the suction stroke and the compression stroke, respectively, of means connecting the spring and pump whereby the product of the force of the spring and its moment arm decreases during the suction stroke of the pump.

2. In a reciprocating pump mechanism, a spring for actuating the pump, a motor for stretching the spring, and connecting means between the pump and spring whereby the product

of the force of the spring and its moment arm is decreased as the spring is extended.

3. In a spring actuated pump, means for extending the spring, and connections between the pump and said means including a rocking lever for decreasing the product of the force of the spring and its moment arm as the spring is extended.

4. In a spring actuated pump, a rocking lever between the spring and pump, and means for rocking the lever, said lever being disposed so that the product of the spring tension and its moment arm decreases as the spring is extended.

5. In a reciprocating pump mechanism, a spring for actuating the pump, a motor for stretching the spring, and connecting means between the pump and the spring whereby the product of the spring force and its moment arm is increased as the spring is contracted.

6. The combination with a pump and a spring for actuating it, of means for extending the spring, and connections between the pump and said means including a rocking lever for increasing the product of the spring force and its moment arm as the spring is contracted.

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