

March 17, 1925.

C. W. DENNIS

1,529,693

PUMPING SYSTEM

Filed May 3, 1922

2 Sheets-Sheet 1

Fig. 1.

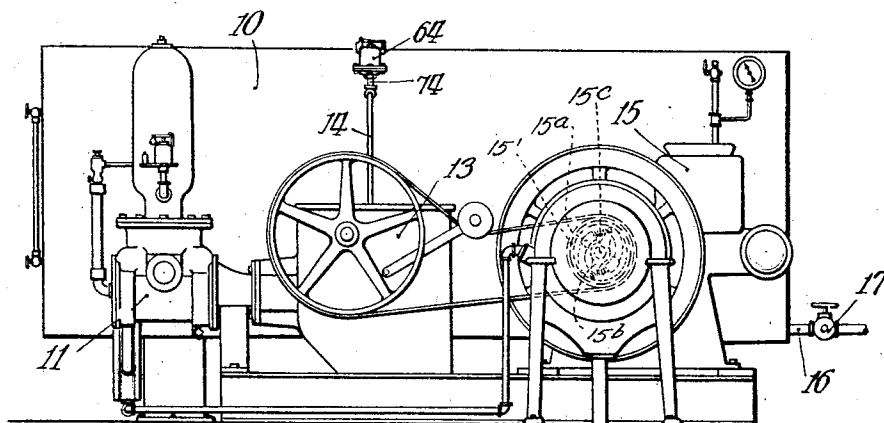
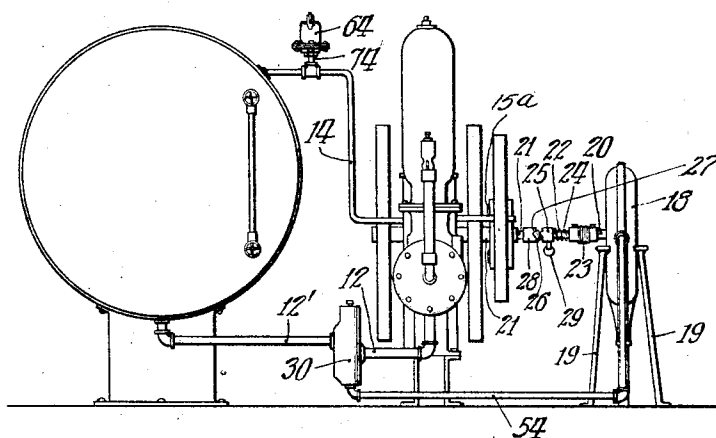


Fig. 2.



Inventor.
Charles W. Dennis
William Bradbury
McCall & Pice Attys.

March 17, 1925.

1,529,693

C. W. DENNIS

PUMPING SYSTEM

Filed May 3, 1922

2 Sheets-Sheet 2

Fig. 5.

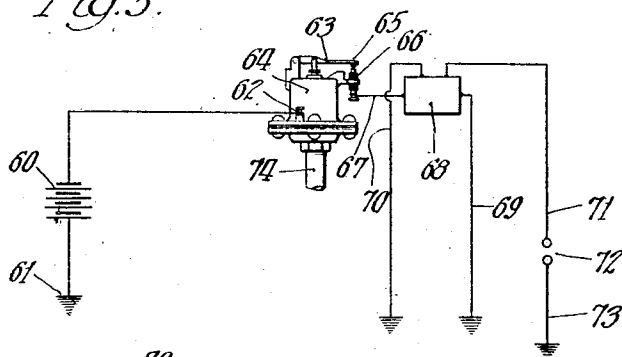


Fig. 3.

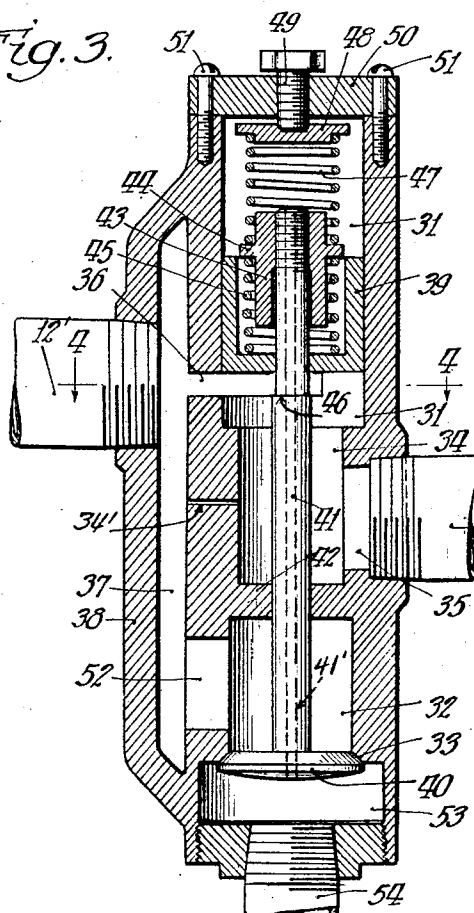
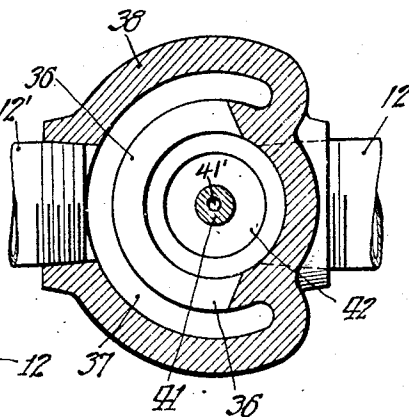


Fig. 4.



Inventor
Charles W. Dennis.
William Bradbury
McCall & Pierce Attys

UNITED STATES PATENT OFFICE.

CHARLES W. DENNIS, OF CHICAGO, ILLINOIS.

PUMPING SYSTEM.

Application filed May 3, 1922. Serial No. 558,072.

To all whom it may concern:

Be it known that I, CHARLES W. DENNIS, a citizen of the United States, and resident of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Pumping Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to improvements in pumping systems, and is particularly concerned with, though not limited to, improvements in pumping systems of the hydraulic-pneumatic type,—that is, a system in which air under pressure is used for forcing the water from a pressure tank to the point or points of consumption.

Briefly speaking, the main object of my invention is to provide a pumping system comprising a pressure tank, air and water pumps for respectively supplying air and water under pressure to the pressure tank, and an internal combustion engine for driving the air and water pumps, means being provided for automatically starting and stopping the internal combustion engine to maintain the pressure in the pressure tank substantially constant, or, at least, to maintain it between predetermined high and low values.

Another object of my invention is to provide a pumping system of the character described, although not limited to one in which the pressure of the air is used for delivering the water to the point of consumption, in which the means for starting the internal combustion engine or motor is controlled by the pressure of the fluid, or fluids, in the pressure tank and actuated by fluid flowing from the pressure tank.

A still further object of my invention is to provide an automatic pumping system, comprising an internal combustion engine and means for automatically starting and stopping it, which is simple in construction, efficient to operate, rugged and reliable.

Other objects will appear as this description progresses, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of a pumping system embodying my invention;

Figure 2 is an end elevation thereof;

Figure 3 is a central longitudinal section through the valve forming a portion of my improved system;

Figure 4 is a transverse section taken on line 4—4 of Figure 3; and

Figure 5 is a more or less diagrammatic and conventional illustration of the ignition circuit forming a part of my system.

Throughout the several views, similar reference characters will be used for referring to similar parts.

In general, the embodiment of my improved pumping system illustrated herein comprises a pressure tank 10 to which water is supplied by the water pump 11 through the discharge conduit comprising the portions 12 and 12'. Air under pressure is supplied to the pressure tank 10 by the air pump 13 through the discharge conduit 14.

The internal combustion engine 15 is provided with a belt pulley 15' which is automatically clutched to the shaft of the internal combustion engine by a speed controlled friction clutch device of well-known construction, the weights 15^a of this device being pivotally mounted upon a spider 15^b secured to the shaft 15^c. The weights and the springs controlling them are so adjusted that the engine shaft would be clutched to the belt pulley when the engine reaches a predetermined speed. The belt pulley 15' is connected with the air pump and water pump by well-known driving connections which need not be described in detail.

When the pumps 11 and 13 are operated by the engine 15, they respectively deliver water and air under pressure to the tank 10. The air collects at the top of the tank and by its expansion forces water out of the tank 10 through one or more discharge pipes 16 when the valve 17, or any other suitable valve, is open.

It is desirable to maintain the pressure in the tank 10 constant, or, at least, to keep it between predetermined high and low values. This means that some means must be provided for automatically starting the internal combustion engine and its associated pumps when the pressure in the tank 10 falls to a predetermined low pressure, and other means for automatically stopping the operation of these elements when the pressure reaches a predetermined high value. For this purpose I provide a water motor 18 which is mounted upon suitable supporting brackets 19, this motor being illustrated as being of the rotary type, and, therefore, comprising the rotary shaft 20 which is connected with the shaft 21 of the internal com-

bustion engine by means of a clutch mechanism which automatically disengages the motor from the internal combustion engine shaft when the speed of the latter exceeds the speed of the shaft 20. The mechanism illustrated herewith is commonly known as the "Bendix" or "inertia" gear shift and comprises a shaft 22 which is connected with the shaft 20 by a universal coupling 23 and which has a spiral thread 24 of rather steep pitch cut on its surface. A sleeve 25 is threaded upon the shaft 22 and provided with teeth 26 for engaging the teeth 27 of the clutch member 28 which is secured to the shaft 21 of the internal combustion engine. Preferably an eccentric weight 29 is secured to the sleeve 25.

Assuming that the internal combustion engine is not operating and that the water motor 18 has started, the shaft 22 will begin to rotate, but the inertia of the weight 29 will prevent the sleeve 25 from rotating and it will be moved toward the clutch member 28 by the action of the threads 24 until its teeth 26 engage the teeth 27 of the clutch member 28, thereby establishing a driving connection between the water motor and the shaft of the internal combustion engine. Continued rotation of the water motor will cause the internal combustion engine to start, and the speed of the latter will increase until the speed of the shaft 21 exceeds the speed of the shaft 22, thereby causing the sleeve 25 to move outwardly along the shaft 22 until its teeth 26 disengage the teeth 27 of the clutch member 28. Thereafter the engine will continue to rotate until it is stopped in the manner about to be described.

I shall now describe the means by which I automatically control the operation of the water motor 18 to start the internal combustion engine. Interposed between the sections 12 and 12' of the discharge conduit of the water pump 13 is a control valve 30 which comprises an elongated body member having a cylindrical bore 31 formed in one end and the valve chamber 32 formed in the opposite end. This chamber is substantially co-axial with the cylinder 31 and the outer open end thereof is beveled, as shown at 33, to provide a valve seat. A bore 34 of reduced diameter forms a continuation of the cylinder 31 and is provided with an inlet port 35 with which the section 12 of the discharge conduit of the water motor communicates.

Adjacent its inner end, the walls of the cylinder 31 are provided with an outlet port 36 which extends a considerable distance around the cylinder, as shown in Figure 4. The outlet port 36 communicates with an annular space 37 formed by the walls of the bores 31 and 34, the valve chamber 32 and an outer wall 38 which extends part way around the body member in spaced relation

to the walls just mentioned. The space 37 in turn communicates with the portion 12' of the discharge conduit of the water pump.

Slidably mounted in the cylinder 31 is a piston 39. The valve 40 which seats upon the valve seat 33 is connected by the piston rod 41, which reciprocates in the bearing 42 separating the valve chamber 32 and the pump 34, with the sleeve 43 having the annular shoulder 44. A compression spring 45, confined between the end of the piston 39 and the annular shoulder 44, yieldingly holds the piston in spaced relation to the sleeve 43. The piston rod 41 is provided with a shoulder 46 which acts as a limiting stop to limit the movement of the piston 39 away from the sleeve 43. A second compression spring 47 is confined between the annular shoulder 44 and a follower 48, the position of which can be adjusted by the set screw 49 which is threaded through the end plate 50 of the cylinder 31. This plate is held in position by means of screws 51, or in any other suitable manner.

It will be noted from an inspection of Figure 3 that the port 52 in the wall of the valve chamber 32, the space 37 and the port 36 provide means for establishing communication between the cylinder 31 and the valve chamber 32, so that the inner surface of the valve 40 is subjected to the same pressure (neglecting static head which is so small as to be negligible) as that imposed upon the end of the piston 39. By making the effective area of the end of the piston 39 larger than the corresponding area of the valve 40, there will be an effective differential pressure tending to move the piston 39 upwardly. The value of this pressure will, of course, depend upon the pressure of the fluid in the cylinder 31 and the chamber 32, and also upon the difference in effective areas of the piston and the valve. In any event the excess pressure exerted upon the piston 39 will tend to move this piston upwardly, thus compressing the springs 45 and 47 and tending to hold the valve 40 in its closed position. The two springs 45 and 47 can be so proportioned that when the pressure in the cylinder 31 and the chamber 32 falls to a certain predetermined value, the tension of the springs 45 and 47 will be greater than the differential pressure tending to hold the piston 39 in its raised position, and it will be forced downwardly by the springs to the lower end of the cylinder 31. Movement of the piston 39 to the lower end of the cylinder 31 is permitted by displacement of the water from the lower end of the cylinder 31 through the port 34' which establishes communication between the bore 34 and the space 37. This movement will open the valve 40 at the same time that the piston 39 moves downwardly and closes the port

36. Water will thereupon be discharged from the tank 10 through the portion 12' of the discharge conduit of the pump, the space 37, the port 52, valve seat 33, chamber 53 into the pipe 54 which conveys the water to the water motor 18 and sets it in motion.

As soon as the water pump begins to operate, the water will be forced through the portion 12' of its discharge conduit into the bore 34 and the lower end of the cylinder 31, thereby causing the piston 39 to rise and closing the valve 40. The upward movement of the piston 39 uncovers the port 36 and permits the water pump to discharge directly into the tank 10, while the closing of the valve 40 cuts off the supply of water to the motor 18 and causes it to cease functioning.

It will be noted that the piston rod 41 is provided with a bore 41' for venting the upper end of the cylinder 31 into the chamber 53 and for equalizing the pressures upon the opposite ends of the piston rod 41. This latter function is of some value when the valve 40 is open, because at this time there is some back pressure in the chamber 53 and pipe 54 which tends to close the valve 40.

While various means may be used for causing the internal combustion engine to quit operating when the pressure in the tank 10 rises to a predetermined value, I prefer to use means substantially like that illustrated in Figure 5 wherein I have shown a conventional type of ignition system for the internal combustion engine comprising a battery 60, one terminal of which is grounded, as indicated at 61, and the other terminal of which is connected with the binding post 62 of a switch 63, the controlling mechanism of which is located in the housing 64. The switch 63 comprises the two contacts 65 and 66 which can be opened and closed. The contact 66 is connected by the conductor 67 with one terminal of the primary of the induction coil 68. The other terminal of this primary is grounded by the conductor 69. One terminal of the secondary of the induction coil 68 is grounded by the conductor 70 and the other terminal is connected by the conductor 71 with a suitable ignition device 72 which may be in the form of a spark plug, or any other similar or equivalent device, one terminal of which is grounded by the conductor 73.

A pipe 74 establishes communication between the housing 64 in which the control mechanism is located and the pipe 14 leading from the air pump to the tank, so that the control mechanism in the housing 64 is controlled by the pressure in the tank. The pressure control and actuated switch described above may be of any well-known construction and detailed description thereof is, for that reason, unnecessary. It is sufficient that it provides means for auto-

matically opening the contacts 65 and 66 when the pressure in the tank 10 reaches a predetermined high value and closing these contacts when the pressure drops to a predetermined low value. Preferably the contacts 65 and 66 close at a slightly greater pressure than that at which the valve 40 is open, so that, when the valve 40 opens, the ignition circuit of the engine is completed, thereby enabling the engine to be started at once.

The operation of my improved pumping system is as follows:

As the pressure in the tank 10 drops, it will reach a predetermined value at which the switch 63 will be automatically closed, thereby placing the ignition system of the internal combustion engine in condition for operation. As the pressure continues to decrease, a point will be reached where the springs 45 and 47 will exceed a differential pressure acting upon the piston 39 and bias the valve 40 to its open position, thereby permitting water under pressure to flow from the tank 10 to the motor 18. As soon as the rotary member of this motor begins to rotate, the two clutch members 25 and 28 will be locked together, whereupon the shaft of the internal combustion engine will be rotated by the motor, thus causing the internal combustion engine to start. As the speed of the internal combustion engine increases, it will soon exceed the speed of the motor 18, whereupon the driving connection between the motor and the engine will be interrupted, as described above. The speed controlled friction clutch between the engine shaft and the belt pulley of the engine can be designed to connect the shaft and the belt pulley either before or after, but preferably after, the connection between the motor 18 and the internal combustion engine has been broken.

As soon as the connection between the driving shaft of the engine and its belt pulley is established, the water pump will begin to operate. The first discharge of water from the water pump will cause the piston 39 to rise and close the valve 40 on its seat, thereby interrupting the supply of water to the motor 18. As the water continues to be pumped into the tank 10, the pressure therein will increase until, at predetermined high value, the switch mechanism will be actuated to its open position, thereby interrupting the primary circuit of the ignition apparatus and thus stopping the engine. By constructing the valve mechanism interposed between the water pump and the pressure tank so that the flow of water from the pump closes the valve 30, I prevent the escape of any considerable amount of water from the tank 10 after the water pump has once been started.

While I have described the details of con-

struction of the preferred embodiment of my invention, it is to be clearly understood that my invention is not limited to these details, but is capable of other adaptations and modifications within the scope of the appended claims.

Having thus described my invention, what I claim is:

1. The combination with a pressure tank, an air pump and a water pump for respectively supplying air and water to said tank, of an internal combustion engine for driving said pumps, an ignition circuit for said engine having a switch controlled by the pressure in said tank, a water motor having a releasable connection with said internal combustion engine, and means for supplying water to said water motor, comprising a valve inserted between said water pump and tank, said valve comprising a body member having a cylinder formed therein, said cylinder having an inlet port connected with said pump and an outlet port connected with said pressure tank, said outlet port being formed in the wall of said cylinder adjacent one end thereof, said body member having a valve chamber provided with an outlet port co-axial with said cylinder, means for establishing communication between said chamber and said cylinder, an outwardly opening valve in said chamber for opening and closing said last-named outlet port, a piston in said cylinder, the effective area of said piston being greater than the effective area of said valve, a rod connecting said piston and valve, and a spring biasing said valve toward its open position.

2. The combination with a pressure tank and a water pump for supplying water to said tank, of an internal combustion engine for driving said pump, an ignition circuit for said engine having a switch controlled by the pressure in said tank, a water motor connected with said internal combustion engine, and means for supplying water to said water motor, comprising a valve inserted between said water pump and tank, said valve comprising a body member having a cylinder formed therein, said cylinder having an inlet port connected with said pump and an outlet port connected with said pressure tank, said outlet port being formed in the wall of said cylinder adjacent one end thereof, said body member having a valve chamber provided with an outlet port, means for establishing communication between said chamber and said cylinder, an outwardly opening valve in said chamber for opening and closing said last-named outlet port, a piston in said cylinder, the effective area of said piston being greater than the effective area of said valve, means connecting said piston and valve, and means biasing said valve toward its open position.

3. The combination with a pressure tank

and a pump for supplying water thereto, of an internal combustion engine for driving said pump, said internal combustion engine having an ignition circuit, comprising a switch controlled by the pressure in said tank, a motor having a releasable connection with said internal combustion engine, and means controlled by the pressure in said tank for establishing communication between said tank and motor when the pressure in said tank reaches a predetermined low value, and means directly actuated by the flow of water from said pump to said tank for destroying said communication.

4. The combination with a pressure tank and a pump for supplying water thereto, of an internal combustion engine for driving said pump, a motor having a releasable connection with said internal combustion engine, and means controlled by the pressure in said tank for establishing communication between said tank and motor when the pressure in said tank reaches a predetermined low value, and means directly actuated by the flow of water from said pump to said tank for destroying said communication.

5. The combination with a pressure tank and a pump for supplying water thereto, of an internal combustion engine for driving said pump, a motor having a releasable connection with said internal combustion engine, and means for establishing communication between said tank and motor when the pressure in said tank reaches a predetermined low value, and means directly actuated by the flow of water from said pump to said tank for destroying said communication.

6. The combination with a pressure tank, an air pump and a water pump, each having a discharge pipe communicating with said pressure tank, of an internal combustion engine for operating both the said pumps, an ignition circuit for said internal combustion engine, comprising a pressure-operated switch controlled by the pressure in said tank, a water motor having a releasable driving connection with said engine, and a valve interposed in said water pump discharge conduit and controlled by the pressure in said tank for connecting said water motor with said tank when the pressure in said tank falls below a predetermined value.

7. The combination with a pressure tank, of a pump for supplying fluid to said tank, an internal combustion engine for driving said pump, automatic means controlled by the pressure of the fluid in said tank for stopping said engine, automatic means controlled by the pressure of the fluid in said tank for starting said engine, and means directly controlled by the flow of fluid from said pump to said tank for making said last-named means inactive.

8. The combination with a pressure tank, of a pump for supplying fluid to said tank, an internal combustion engine for driving said pump, automatic means controlled by the pressure of the fluid in said tank for stopping said engine, and automatic means located between said pump and tank and controlled by the pressure of the fluid in said tank for starting said engine.

9. The combination with a pressure tank, of a pump for supplying fluid to said tank, a motor for driving said pump, automatic means controlled by the pressure of fluid in said tank for stopping said motor, automatic means controlled by the pressure of the fluid in said tank for starting said motor, and means directly controlled by the flow of fluid from said pump to said tank for making said last-named means inactive.

10. The combination with a pressure tank, of a pump for supplying fluid to said tank, an internal combustion engine for driving said pump, and automatic means directly controlled by the pressure of said tank and by the flow of fluid from said pump for automatically starting and stopping said engine, to keep the pressure in said tank between predetermined high and low values.

11. The combination with a tank, of a pump for supplying fluid to said tank, an internal combustion engine, a speed controlled clutch for connecting said engine with said pump, means controlled by the pressure of the fluid in said tank for automatically starting and stopping said pump, and means directly actuated by the flow of fluid from said pump for rendering said starting means inoperative.

12. The combination with a tank, of a pump for supplying fluid to said tank, a motor for driving said pump, means for automatically connecting said motor with said pump when the speed of said motor reaches a predetermined value, means controlled by the pressure of fluid in said tank for automatically starting and stopping said motor, and means directly actuated by the flow of fluid from said pump for rendering said starting means inoperative.

13. The combination with a tank, of a pump for supplying fluid to said tank, an internal combustion engine for driving said

pump, a fluid motor for starting said internal combustion engine, and means controlled by the pressure in said tank and directly by the flow of fluid from said pump for automatically starting and stopping said fluid motor.

14. The combination with a tank, a pump for supplying fluid to said tank, an internal combustion engine for driving said pump, and a fluid motor for starting said internal combustion engine, of a valve located between said pump and tank for controlling the passage of fluid to said motor, and means for closing said valve immediately said pump starts pumping.

15. In combination with a fluid pressure system comprising a tank, a pump, a conduit connecting said pump with said tank, driving means for said pump, starting means for said driving means, fluid conveying means between said conduit and said starting means, a valve therein, and means for effecting a pressure differential in said conduit to close said valve.

16. In combination with a fluid pressure system comprising a tank, a pump, a conduit between said tank and pump, driving means for said pump, means for effecting a pressure differential in said conduit, starting means for said driving means, fluid-conveying means comprising a valve between said conduit and said starting means, means tending to open said valve, and a tube adapted to convey high pressure fluid from said conduit to said valve to close the same.

17. In combination with a fluid pressure system comprising a tank, a pump, a conduit therebetween, driving means for said pump, starting means for said driving means, fluid-conveying means between said conduit and said starting means, a valve for said conveying means, a spring tending to open said valve, and means whereby said valve is automatically closed upon actuation of said pump.

In witness whereof, I hereunto subscribe my name this 1st day of May, 1922.

CHARLES W. DENNIS.

Witnesses:

EDNA V. GUSTAFSON,
EMILE J. BOURGEOIS.