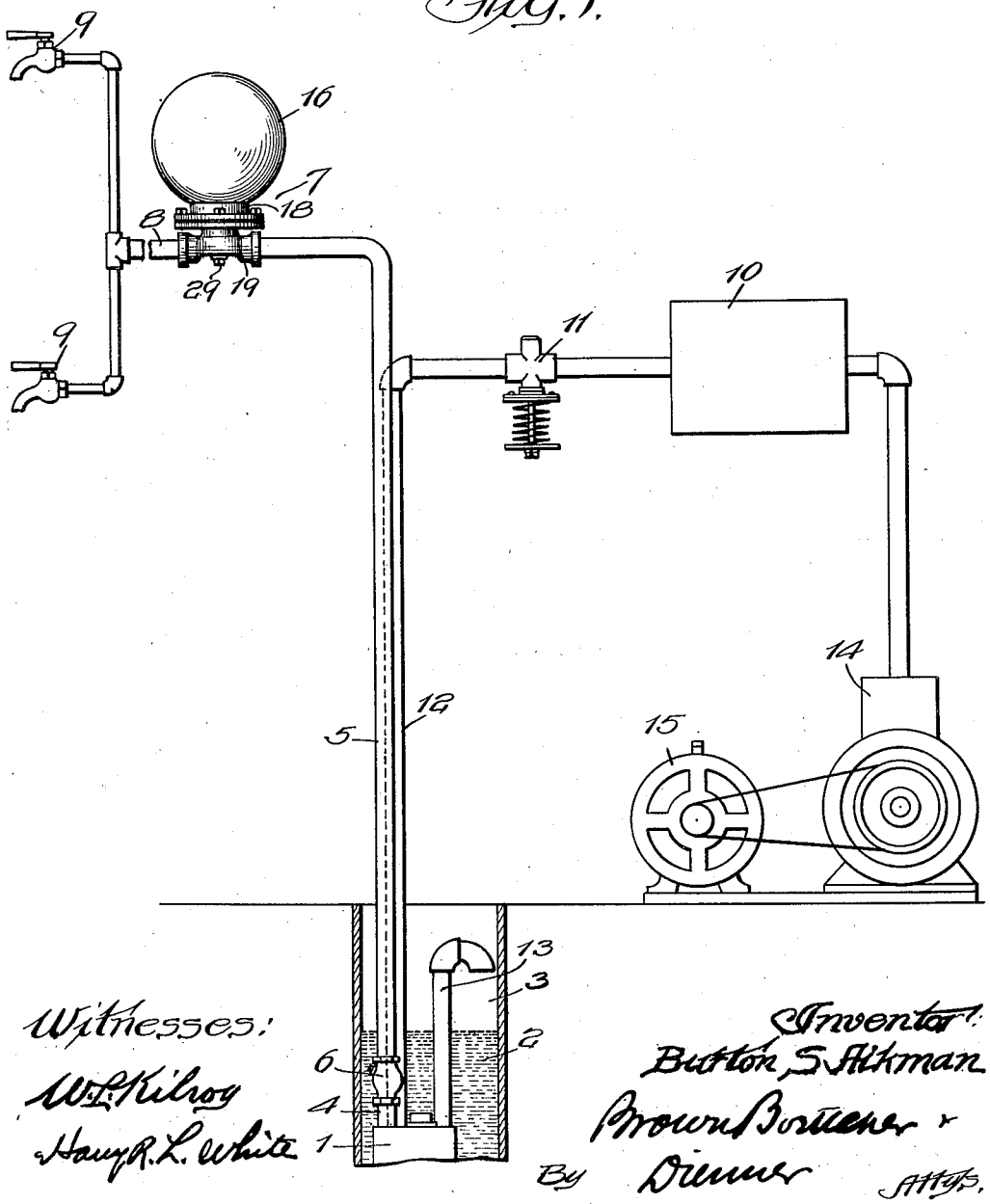
July 17, 1923. 1,462,159

B. S. AIKMAN

PUMPING SYSTEM

Filed March 30, 1921 2 Sheets-Sheet 1

Fig. 1.



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July 17, 1923. 1,462,159

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PUMPING SYSTEM

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Fig. 2.

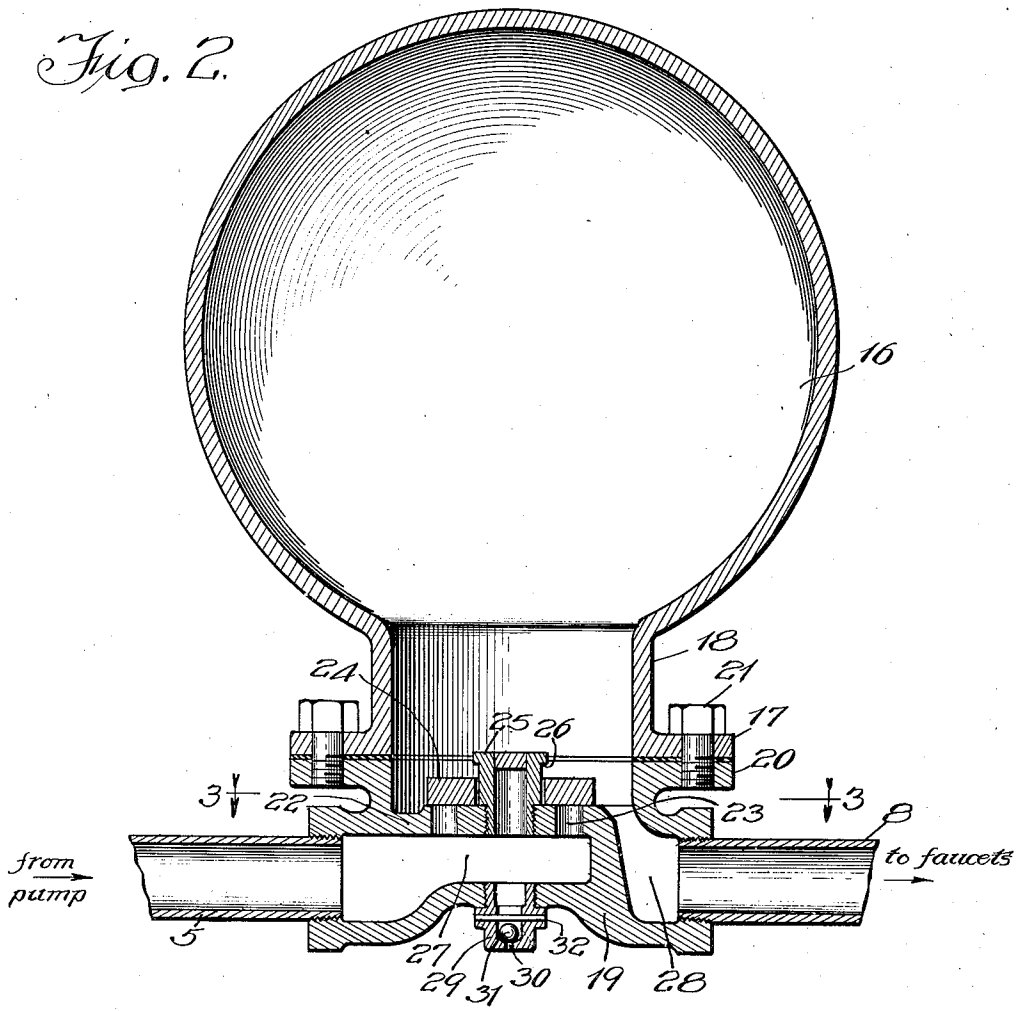
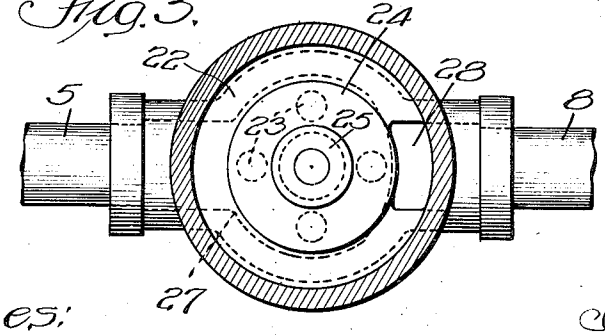


Fig. 3.



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UNITED STATES PATENT OFFICE.

BURTON S. AIKMAN, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO NATIONAL BRAKE & ELECTRIC COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

PUMPING SYSTEM.

Application filed March 30, 1921. Serial No. 456,842.

To all whom it may concern:

Be it known that I, BURTON S. AIKMAN, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, 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 pumping systems of the pneumatic displacement type, and more particularly of the type designated as fresh water or faucet controlled systems, although the invention may be applied to other systems.

In systems of this character a pump is submerged in the liquid to be pumped, and the discharge of liquid from this pump occurs only when the outlet is opened, the displacement of water from the pump being prevented by stalling or back pressure of the liquid against the displacing air, or other elastic medium. My invention has to do particularly with pumps of this character, which are of the single cylinder type, or such pumps as may have an irregular discharge or delivery. In systems having an irregular discharge from the pump, it is necessary to employ some means for smoothing out the variations in flow from the pump. This is generally done by connecting what is known as an air spring or steady flow chamber to the discharge system between the pump and the outlets. Heretofore, such steady flow chambers have been subject to the difficulty that they become filled with water, thereby losing the air spring effect. This occurs either through leakage of the air in the top of the chamber, or by solution of the air with liquid. Another difficulty is the relatively low efficiency of air springs as heretofore constructed, due to the compressibility of the elastic medium, generally air, held in the top of the chamber. If the chamber is filled with air at atmospheric pressure, and the system is then put under hydraulic pressure, through the medium of the pump, the air will be compressed by the water, with the result that the air occupies only a relatively small proportion of the volume of the chamber.

It has been proposed to re-charge the steady flow chamber with air from the pressure tank of the system, either by a manually controlled connection, or by an automatically controlled connection. If the connection is manually controlled, the attendant generally will not admit air when it is required, or will admit too much when he does operate the device, with the result that the system is unsatisfactory. Where an automatic connection is applied, opening of a number of outlets simultaneously may reduce the pressure in the steady flow chamber to such a degree as to permit too much air to enter the system, thereby rendering such an arrangement unsatisfactory.

According to my invention, I provide means for introducing a small amount of air into the system at each stroke of the pump, this air being introduced at the steady flow chamber, and only when the pump is operated. The result is that the steady flow chamber is always maintained in fully charged condition, and any excess of air will be carried off in small amounts during normal operation, so that at no time is any appreciable amount of compressed air injected into the delivery system.

My invention operates on the principle of pneumatics involved in the formation of the Torricellian vacuum; that is to say, a definite atmospheric pressure will sustain a definite column of water or other liquid, and a portion of said column of water will equalize a certain portion of the atmospheric pressure. I secure the advantages of this principle by two methods: first, by arranging two check valves in a pipe, part of which pipe is vertical, and permitting the upper check valve to close more quickly in point of operation than the lower check valve by a predetermined amount, whereby the column of liquid moving downwardly will close the second check valve after the first check valve is seated, and will produce a reduction of pressure equal to the static head of the column. Second, I may permit

a small leak or by-pass about the lower check valve, so that the column of liquid between the check valves may recede and create a reduction in pressure. I cause this reduction in pressure in both cases to draw air into the pipe. I provide an inlet port, preferably at the top of the column for permitting air to enter to satisfy the reduction in pressure, and provide a check valve for this inlet port to prevent outward movement of any of the contents of the pipe. This group of elements is preferably contained in the discharge pipe between the pump and the steady flow chamber, with the result that upon the next stroke of the pump, the air which has been drawn in will be compressed and forced into the steady flow chamber. If the steady flow chamber is already full the air will be driven over to the outlets, a small amount at each stroke of the pump.

In the preferred embodiment of my invention, I construct the upper check valve and the air inlet check valve in a single unitary structure, as will be more apparent from the following detailed description.

In order to acquaint those skilled in the art with the preferred embodiment of my invention, I shall now describe the embodiment illustrated in the accompanying drawings, in which:

Figure 1 is a diagrammatic showing of a system embodying my invention;

Figure 2 is a vertical, longitudinal section showing the combined steady flow chamber, water check valve and air inlet valve; and,

Figure 3 is a horizontal section taken on the line 3—3 of Figure 2.

As shown in Figure 1, a single cylinder pump 1 of any preferred construction is submerged in the water 2 of the well 3. This pump has the usual water inlet valve and air control valves (not shown), for securing satisfactory operation of the pump. The pump has a water discharge connection 4 connected to the water discharge pipe 5 through a check valve 6. The water discharge pipe 5 leads to the combined steady flow chamber and air injector 7, and from thence leads to the outlets, in this case shown as the faucets 9. The pump is supplied with compressed air from a tank 10 through a reducing valve 11, and the air pipe 12 for discharging the water into the system. The pump is provided with an exhaust pipe 13, preferably to prevent the exhaust air from stirring up the water in the well.

The air tank 10 may be re-charged with compressed air by means of the compressor 14, which may be driven by any suitable power device, such, for instance, as the motor 15.

The combined steady flow chamber and air inlet valve comprises the spherical chamber 16 having a flange 17 connected thereto by a short neck 18. A valve body 19 has at its upper side a similar flange 20, to which the flange 17 is secured in any preferred manner, as, for instance, by the cap screws 21. The flange body 19 provides a connection at one end for the water discharge pipe 5, which connects through the check valve 6 with the chamber 1, and on the other side provides a connection for the pipe 8 which leads to the faucets. A web 22 provided with a series of openings 23, forms a valve seat for the disc valve 24. The disc valve is mounted on a guiding pin 25, which has a shoulder 26 at its upper end for limiting the lift of said valve. Since there are a number of ports 23, a small amount of lift of this valve will suffice to give a clear opening for the discharge of water from the pump to the faucets. The web 22 separates the passageways 27 and 28, the passageway 28 leading to the faucets, and the passageway 27 leading to the pump. The passageway 28 communicates with the interior of the steady flow chamber 16 without hindrance, and communicates with the passageway 27 through the valve 24.

Below the valve 24, and preferably axially in line therewith, I provide the plug 29, which has an air passageway 30 formed therethrough, this passageway being controlled by a metal ball 31, which forms a check valve for preventing the discharge of any flow outwardly. A pin 32 forms a guard preventing the displacement of the metal ball 31. The ball 31 which forms the valve is closed by gravity, but obviously a spring might be employed.

The operation of the device is as follows:—

Assuming that the tank 10 has been properly charged with compressed air, and that the system is to be put into operation. The pump 1 being lowered into the well 3 below the level of the liquid 2, automatically fills with liquid, and causes the admission of compressed air to discharge liquid into the discharge pipe 5, and from there through the check valve 24 into both the air spring 16 and the distributing system 8, 9. The faucets 9 at this time are closed. Consequently, the pump will discharge water until the air in the air spring 16 has been compressed to substantially the pressure of the air in the pump 1. Any air trapped in other parts of the system will also be compressed at this time. Since the air spring 16 was filled with air at atmospheric pressure, the compression of this body of air will reduce the volume thereof in proportion with the well known laws of Charles and Boyle, namely, that if the temperature is constant the volume is inversely proportional to the pressure. If the faucets are

now opened the water which is trapped in the system will first be discharged, and thereafter the liquid will flow from the faucets so long as they are open. The amount of air contained in the air spring 16 may be insufficient to smooth out the flow between strokes of the pump 1, this pump being a single cylinder pump.

It is for the purpose of introducing sufficient air into the air spring 16 to cause it to function properly as an air spring that my invention is designed. As I have constructed the apparatus herein illustrated, I employ the two check valves, namely, 6 and 24, with the lift of the check valve 24 smaller than the lift of the check valve 6. This means that upon each exhaust of air from the pumping chamber 1 there will be a tendency for the column of liquid contained in the distributing main 8, steady flow chamber 16 and discharge pipe 5 to move back into the pumping chamber 1. There are two forces tending to cause this: first, the weight of pressure which exists in the distributing pipe 8, and steady flow chamber 16; and, second, the weight of the column of liquid in the portion of the discharge pipe 5 which extends vertically. When the body of the liquid starts to move backwardly towards the pump 1, the check valve 24 and the check valve 6 both begin to move towards their seats respectively. Since the check valve 24 requires less movement to close than does the check valve 6, the check valve 24 will be closed while the column of liquid in the discharge pipe 5 is still moving backwardly through the check valve 6. This reverse movement of the body of liquid below the check valve 24 tends to create a reduction in pressure at the upper end of the discharge pipe 5. The pressure of the outside atmosphere exceeding the pressure within the space 27 thereupon opens the check valve 30 of the air inlet port, and causes the pressure vacuum which has been created to be satisfied by the inflow of a small amount of air. Upon the next stroke of the pump the liquid in the discharge pipe 5 is again placed under pressure, this pressure being transmitted to the small body of air which has been drawn into the system, causing the air to be discharged through the check valve 24, where it may rise by its buoyancy into the upper portion of the air spring 16. If the air spring 16 is full, the air which is thus injected into the system will merely be carried over with the water flowing to the faucets. Since this injection of air occurs only while the pump is operating, it is apparent that no appreciable amount of air can accumulate at the faucets.

It is obvious to those skilled in the art that the lower check valve 6 may be dispensed with under certain circumstances, for instance, where the vertical distance from the pump to the steady flow chamber is relatively small.

The reason I employ the check valve 6 in this system is to hold the column of water against too great recession thereby to prevent the introduction of more than the desired amount of air into the discharge pipe 5. The amount of air that is drawn in may be controlled by the size of the orifice 30, since the size of said opening controls the rate at which air enters. If the check valve 6 were not employed, a relatively great amount of air would be drawn into the system, which would be detrimental to its operation.

This principle may be employed for the injection of a gas into liquid for other purposes than for replenishing the air in an air spring. I am, therefore, claiming the invention as broadly as is consistent with the prior art.

I do not intend to be limited to the details shown and described.

I claim:

1. In a steady flow chamber, a base having an inlet and an outlet substantially on the same level, a chamber mounted on and secured to the base, a horizontally extending partition between said inlet and outlet, said partition having a relatively large valve port therethrough, a check valve of relatively small lift controlling said port and seating thereupon by gravity, an air inlet valve comprising a valve body mounted in the lower wall of the base below the partition, a valve port through said body having an internal seat, and a valve held on said latter seat by gravity.

2. In combination, a pump, a steady flow chamber, a pipe connecting said steady flow chamber and said pump, a pair of check valves in series in said pipe, one being disposed a substantial vertical distance above the other, said upper valve having a smaller lift than the lower valve and an air inlet check valve adjacent the upper check valve for admitting air into the pipe.

3. In combination, a pneumatic displacement pump having a vertically extending discharge pipe, a check valve for said pipe adjacent the pump, a steady flow chamber at the upper end of said pipe, a check valve of relatively larger port area than said first valve adjacent said steady flow chamber and an air inlet check valve opening into said pipe adjacent said steady flow chamber.

4. In combination, a pump adapted to have a pulsating discharge, a vertically extending pipe, a check valve for said pump adjacent the lower end of the pipe, a steady flow chamber connected in said pipe a substantial distance above the pump, a check valve of relatively large port area in said pipe adjacent the steady flow chamber and an air inlet check valve opening into said pipe adjacent said latter valve.

5. In combination, a pump having a pulsating discharge, a discharge pipe, a first check valve in said pipe, a second check valve in the same pipe, said first check valve being adapted to seat before the second check valve seats, and an air inlet check valve for said pipe adjacent said first valve and adapted to inhale air into the pipe below said first valve.

In witness whereof, I hereunto subscribe my name, this 25th day of March, A. D. 1921.

BURTON S. AIKMAN.