F. J. KIMBALL.

AIR LIFT.

APPLICATION FILED NOV. 9, 1911.

1,039,958. Patented Oct. 1, 1912.

Fig. 1.

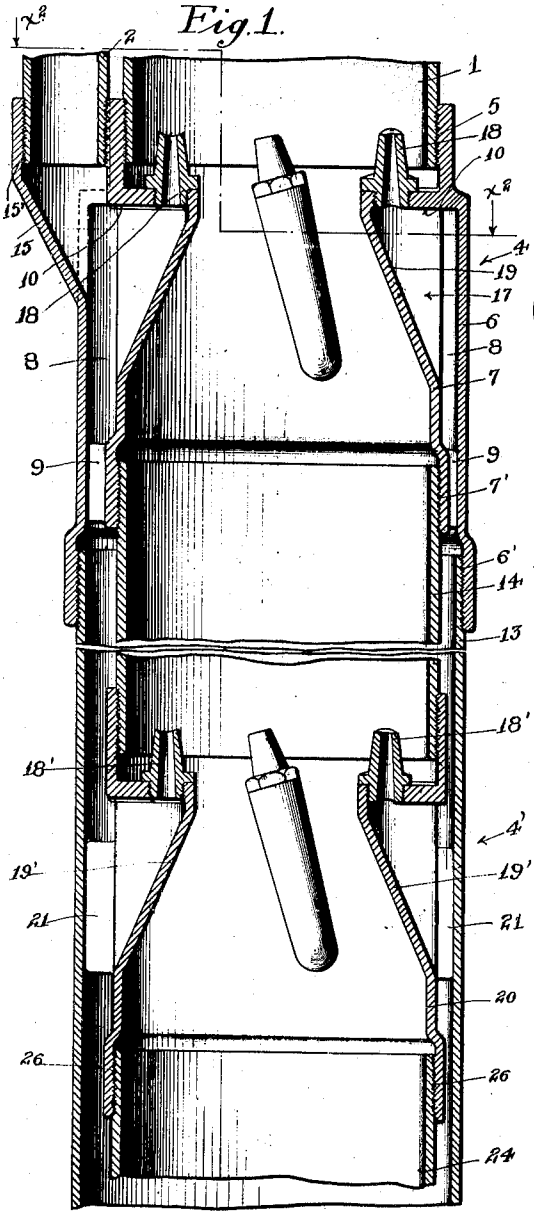


Fig. 2.

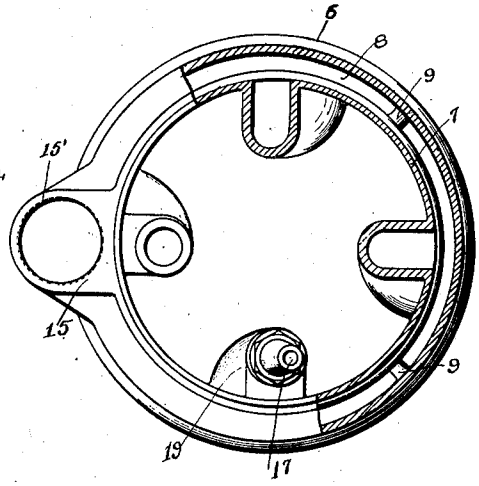
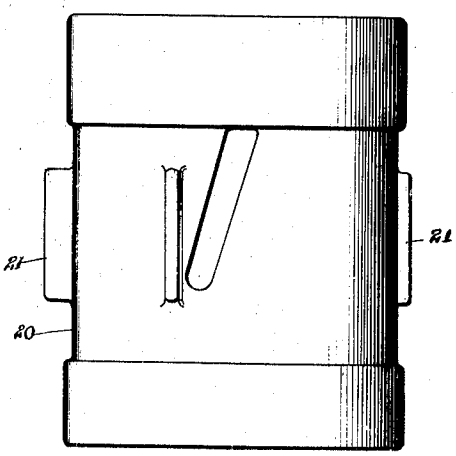


Fig. 3.



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UNITED STATES PATENT OFFICE.

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AIR-LIFT.

1,039,958. Specification of Letters Patent. Patented Oct. 1, 1912.

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To all whom it may concern:

Be it known that I, FRANK J. KIMBALL, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Air-Lift, of which the following is a specification.

This invention relates to means for pumping water, oil, or other fluids from wells by the action of air forced into the column of fluid, and the main object of the invention is to provide for regulation of the operation of the air-lift.

A further object of the invention is to provide for regulation of the operation of the air-lift with minimum variation in the pressure supplied from the compressor.

Another object of the invention is to provide means for keeping the pump head clear of sand so as to prevent the same from clogging.

Other objects of the invention will appear hereinafter.

The accompanying drawings illustrate an embodiment of the invention, and referring thereto: Figure 1 is a vertical section of the pump head. Fig. 2 is a transverse section on line x^2—x^2 in Fig. 1. Fig. 3 is an elevation of the lower nozzle collar for the pump head.

1 designates a tubular well casing which extends down into a well and is provided at its lower end with the pump head for forcing air into the column of water or other liquid in the casing, such air being supplied through a supply pipe 2 extending into the well, alongside of the casing 1, and connected to the pump head to supply air thereto.

The pump head comprises a plurality of sections arranged one above the other. In the present case, I have shown two sections, which sufficiently illustrate the principles of the invention. The upper section consists of a tubular member 4 having a screw threaded upper end portion 5, screwing onto the casing 1, said tubular member being provided with an outer wall 6 and an inner wall 7 separated by an annular air space or chamber 8, spacers 9 being provided, extending between the inner and outer walls to rigidly connect the same, but to allow free passage of air around the inner wall and from top to bottom of the air space. The air space is closed at the top as shown at 10, the inner wall 7 being substantially continuous with the inside of the casing 1, and the outer wall 6 being of sufficiently greater diameter to provide for the air space 8. The said air space is open at its lower end, the outer wall 6 being provided at its lower end with an extension 6′ of somewhat larger diameter into which screws the outer wall or casing 13 for the lower section. The inner wall 7 is also provided with an extension 7′ of larger diameter, screw threaded for connection to the inner casing 14, leading to the lower section. The outer wall 6 is formed with an outward extension 15 at its upper end, screw threaded as at 15′ to receive the air supply pipe 2, said extension establishing communication between said air supply pipe and the air space 8. A plurality of nozzles 18 are connected to the said air space or chamber 8, said nozzles being screwed or otherwise secured to hollow lugs 19 extending inwardly from the inner wall 7, the chambers or passages 17 within said lugs flaring upwardly and the inner walls of said lugs extending obliquely inward and upward to conduct the air with minimum resistance to the nozzles 18. The said lugs 19, the air passages 17 therein and the nozzles 18 connected thereto are preferably inclined to the longitudinal axis of the head and casing so as to discharge the air from the nozzles in an oblique direction, giving a tangential or rotary component of motion to the air and to the water for the purpose hereinafter set forth. This rotative or whirling action is due not only to the tangential movement given to the issuing air, but also to the action of the inclined lugs themselves, acting as deflectors to cause whirling movement of the water.

The lower pump head section 4′ is arranged at any desired or suitable depth below the upper section 4′, say 2 to 6 feet, the outer casing 13 connected to the upper section, forming, for example, the outer wall for the lower section, and the inner wall of said section comprising a tubular member or sleeve 20 screwing onto the inner casing 14 aforesaid, and separated from the outer wall 13 by spacers 21 which may be cast on the inner wall, forming an air space continuous with the space in the upper pump head section. The lower pump head section is provided with nozzles 18′ similar to the upper nozzles above described and extending obliquely to

the axis of the pump casing, said nozzles being attached to oblique inwardly extending lugs 19′ which are formed with air passages establishing communication from the said air space to the said nozzle. An inner suction casing 24 is screwed into the lower end of the inner tubular member 20 as indicated at 26 and extends to any desired depth in the well, the outer and inner casings 13 and 24 being immersed in the water or fluid in the well. The upper and lower sections form a tubular pump head having a continuous internal passage which connects the suction casing 24 to the well casing 1. The nozzles of the upper and lower sections open into this cylindrical internal passage and are arranged at different heights so as to provide for regulation as hereinafter set forth.

The operation is as follows:—Assuming that the air-lift is working on partial capacity, for example, 75% of its full capacity, the pressure furnished through the supply pipe 2 is sufficient to depress the water in the space 8 below the level of the nozzles 19 of the upper stage or section, but not below the lower nozzles of the lower stage or section, so that air will issue only through said upper nozzle. The air is ejected through the upper nozzles into the rising column of water at such an angle as to produce a spiral or rotating motion of the water, the purpose of this being to maintain a film or layer of air on or near the surface of the delivery pipe, thereby reducing the friction or resistance to the upward passage of the water. In case the well is to be operated at full capacity, the pressure of the air supply is increased by two or three pounds per square inch, this being sufficient to force the level of water in the space 8 below the nozzles 19′ in the lower stage or section. The amount of air that then issues through the nozzles is increased not only by the greater velocity of outflow due to the increased pressure but in much larger ratio by reason of the doubling of the effective outlet for the air, the air issuing through the lower nozzles as well as through the upper nozzles. It will be understood that the upper nozzles present a certain resistance to the passage of the air therethrough, which increases with the pressure and as the pressure is increased in the supply pipe and in the air space 8, the resistance in the nozzles holds back the pressure so as to force the air to find an additional outlet through the lower nozzle. Thus, a comparatively small increase in the pressure from the compressor will give a large increase in the lifting capacity of the air lift.

When operating two or more wells with this air-lift system, it is unnecessary to regulate the flow of each well with a valve at the surface of the ground. Thus if two or more air-lifts of this design are operating in the wells, the valves at the surface of the ground may be left wide open, and if sufficient air is delivered by the compressor to operate each air-lift to 75% of its capacity, the upper stage in each air lift will discharge air. If it is desired to increase the capacity from each of the three air lifts to full capacity, it is only necessary to increase the volume of air in the compressor to full capacity, and this increased volume of air delivered to the wells cannot discharge through the nozzles in the upper stage. Therefore, a slight increase in pressure will occur, which will force the water in the air space below the nozzles in the lower stage, which will permit a discharge of this surplus air through the lower stage nozzles, thereby increasing the water proportionately from all of the three wells. This system permits of the engineer or operator to increase or decrease the flow of water from the wells by simply increasing or decreasing the speed of the compressor, and does not require his attention or regulation at the wells. This range of regulation may be varied to suit the conditions of the wells that are to be pumped by adding as many stages as may be necessary.

The space or chamber between the inner and outer walls of the air-lift pump head being open at the bottom, any sand which finds its way into said space can fall or precipitate through the open bottom of this space, so that there is no danger of clogging of the pump head.

What I claim is:

1. An air-lift comprising, in combination with a well casing, a tubular pump head connected to the lower end of said casing, and provided with an air chamber, means for supplying compressed air to said chamber, and a plurality of nozzles extending upwardly from said chamber and opening at their lower ends into said chamber and opening at their upper ends into the interior of the tubular pump head at different levels.

2. An air-lift comprising, in combination with a well casing, a tubular pump head connected to the lower end of said casing, and provided with an air chamber, means for supplying compressed air to said chamber, and a plurality of nozzles communicating with said chamber and opening into the interior of the tubular pump head at different levels, the lower end of said air chamber being open.

3. In an air lift, the combination with a well casing, of a tubular pump head connected to the lower end of said casing, and provided with an annular air chamber extending around the internal passage of the pump head, means for supplying compressed air to said chamber and a plurality of lugs extending from the wall of said pump head into said internal passage, said lugs being

inclined and being formed with obliquely extending nozzles communicating with said air chamber and with said internal passage whereby a whirling motion is imparted to the water by the deflecting action of said lugs and by the oblique motion of the air issuing from said nozzles.

In testimony whereof, I have hereunto set my hand at Los Angeles, California this 3rd day of November 1911.

FRANK J. KIMBALL.

In presence of—

ARTHUR P. KNIGHT,

GLADYS RUSSELL.