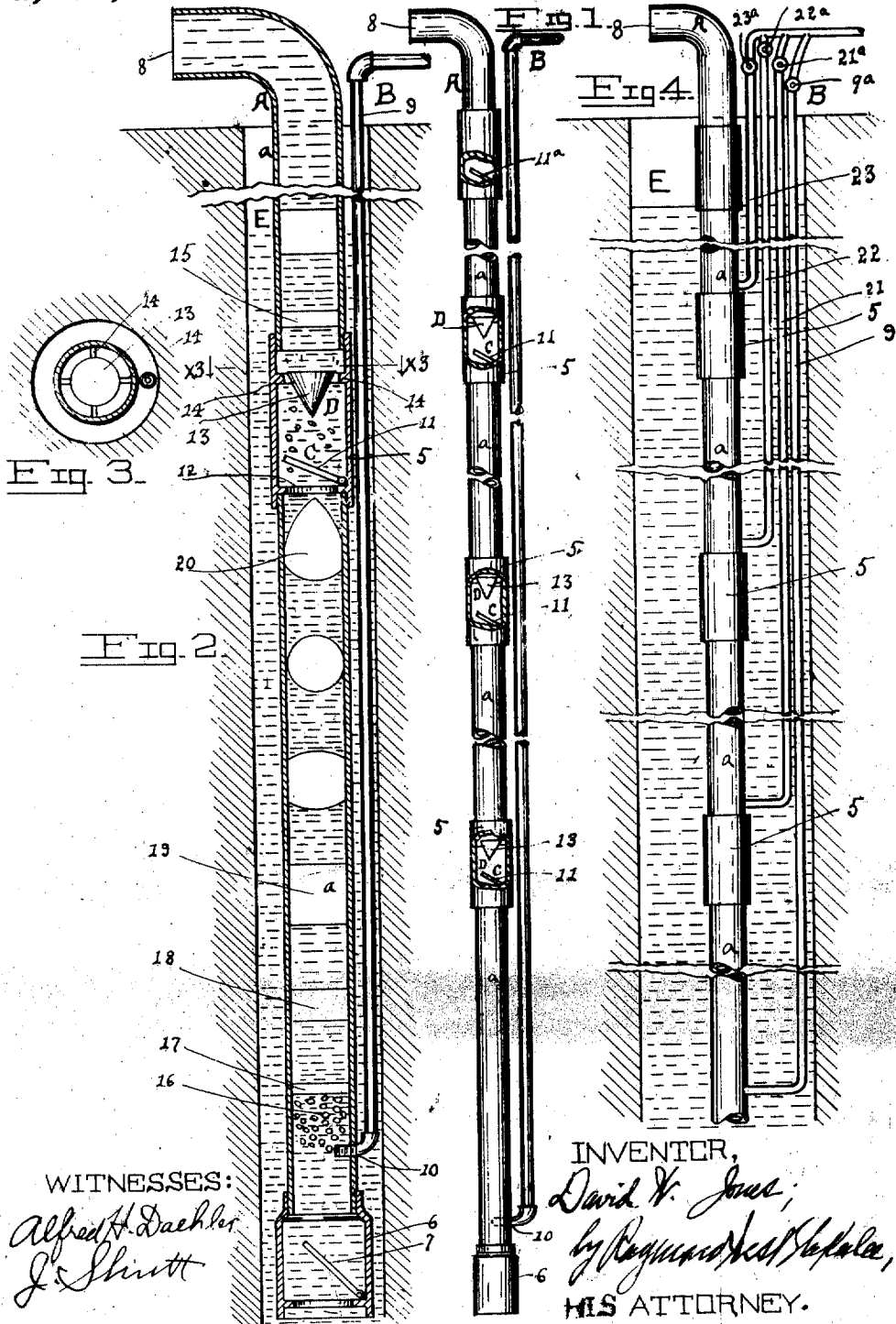


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METHOD OF AND APPARATUS FOR PUMPING FLUIDS.  
APPLICATION FILED AUG. 4, 1916.

1,276,373.

Patented Aug. 20, 1918.



WITNESSES:  
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# UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR PUMPING FLUIDS.

1,276,373.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, DAVID W. JONES, a citizen of the United States of America, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Methods of and Apparatus for Pumping Fluids, of which the following is a specification.

10 This invention relates to a method of and apparatus for pumping fluids, and it has for its object to provide a novel method and simple apparatus of the nature stated for carrying out the method, whereby fluids 15 may be pumped or raised to considerable heights with a minimum expenditure of energy.

In accordance with the invention, compressed air or other fluid is delivered into 20 a tube or the like at a point below the level of the fluid to be pumped and into which the tube extends and is partially immersed, such air or working fluid causing the fluid in the tube to rise in accordance with the 25 well-known air-lift principle, the fluid being carried past a check valve in its ascent and being thus brought into another stage for further traverse of the tube. The fluid may be passed through as many such stages as 30 may be necessary or desirable in any particular installation; furthermore, after the fluid being pumped and the working fluid associated with the same passes the check valve to enter another stage, the working 35 fluid may be rearranged, with respect to the fluid being pumped, to secure greater working efficiency and increased range. This rearrangement or readjustment of working fluid entrapped in the fluid being pumped, 40 in each stage, is preferably made along the lines producing the highest efficiency. I have determined that by restratifying the air or working fluid in the fluid being pumped the maximum efficiency in apparatus 45 of this character may be attained. When compressed air or the like is introduced into a column of liquid in a tube and under the conditions under which pumps of this general nature operate, a portion of the air at the point of injection into the liquid takes the form of small bubbles, which afterward gather and form into layers of air, disposed between layers of liquid, and later and in the ascent of the air and 50 liquid the layers of air progressively thicken and assume spherical and bulbous forms

prior to breaking through the liquid in escaping therefrom. Therefore, means interposed in the path of the escaping air for restratifying it will cause the buoyant 60 energy of the air to be again properly applied to the work of lifting the liquid and such means may be at such intervals in the pipe or tube as may be necessary for obtaining the best results in any given installation, 65 and one such means is associated with each of the check valves in the different stages above referred to. An inverted cone centrally disposed in the tube or pipe and just above one of the check valves provides 70 highly efficient means for rearranging the air or other working fluid.

In the drawing:

Figure 1 is a fragmentary side elevation of a pump organized and constructed in accordance with the invention and capable of 75 carrying out the method of the invention, parts being broken away and sectioned for clearness of illustration;

Fig. 2 is a fragmentary central vertical 80 sectional view of the pump shown in Fig. 1, the same being shown as installed in a well hole;

Fig. 3 is a horizontal sectional view taken on the line  $x3-x3$ , Fig. 2, and looking in the direction of the appended arrows; and 85

Fig. 4 is a fragmentary side elevation of a modified form of pump organized in accordance with the invention, the same being shown as installed in a well hole. 90

Corresponding parts in all the figures are designated by the same reference characters.

Referring with particularity to the drawing in the embodiment of the invention therein shown, A designates the tube of the improved pump, B designates air supply means therefor, C designates, in each instance, a check valve disposed in the tube A, D designates, in each instance, means for rearranging the working fluid with respect to the fluid being pumped, and E 100 designates liquid in the well hole and to be pumped therefrom by the apparatus.

The tube A is shown as comprising a plurality of sections  $a$  joined together by means 105 of valve casings 5, the lowermost of such sections  $a$  terminating at and being joined to a valve housing 6 in which is disposed an inwardly opening check valve 7 which may be of any preferred form, and the 110 uppermost of the sections  $a$  terminates in a discharge spout 8.

The air supply means B, in Figs. 1, 2 and 3, preferably consists of a pipe 9 leading from any suitable supply of compressed air or other working fluid into the well hole and beneath the surface of the liquid to be pumped where it enters the lowermost tube section *a* slightly above the check valve 7 as at 10.

Each of the check valves C preferably consists of a disk 11 adapted to coact with a seat 12 one being provided in each valve casing 5 and permitting the rise of fluids past such valve but preventing a return flow. It will, of course, be understood that any other suitable check valve may be employed in lieu of the form shown.

Each of the means D for rearranging the working fluid preferably comprises an inverted cone 13 disposed in a valve chamber 5 and maintained in position therein as by supporting webs 14 so as to provide an interspace between the edges of the base of the cone and the walls of the respective valve chambers 5. Each of the cones 13, coacting with the respective valve C immediately beneath the same serves to break up the bulbous formation above referred to, the bulbous bubbles impinging on the valve C breaking up and the air of such bubbles taking on a new form which by further ascent is modified by the cone 13 and by being passed over the same is again stratified in the column of liquid being pumped as at 15, Fig. 2. The change of form of the air bubbles entrapped in the liquid in the tube is shown in Fig. 2, the air on entering taking the form of small bubbles 16 mixed with the liquid, such bubbles later collecting or uniting and forming a stratum as at 17, which stratum progressively increases in thickness as at 18 and 19 and finally assumes the bulbous form shown at 20, which form is assumed just before the air would, if not rearranged, break through the column of liquid in the tube.

In the modified form of the invention shown in Fig. 4, the air supply means B comprises, in addition to the pipe 9 which leads to the lowermost portion or zone of the pump, pipes 21, 22 and 23, each of such pipes being connected with a tube section *a* at a point just above one of the valve casings 5 in which is disposed a check valve 11 and a cone 13. The pipes 9, 21, 22 and 23 are provided with controlling valves 9<sup>a</sup>, 21<sup>a</sup>, 22<sup>a</sup> and 23<sup>a</sup> whereby compressed air or other working fluid may be admitted to each of the sections of tubing *a* independently. By this arrangement of air supply pipes a mine or the like may be economically pumped, as, after the pump is installed, assuming the liquid level to be above the first valve casing 5, by opening the valve 23<sup>a</sup> air will be admitted to the upper section only and after the air so admitted has caused the ejec-

tion of liquid in sufficient amount to lower the level in the mine so that the next section will have to be put into operation to further eject liquid, the valve 23<sup>a</sup> may be closed and the valve 22<sup>a</sup> opened to admit air from the air supply to the next lower section. This pumping of section after section is continued until the water in the mine is brought to the desired level. It will, of course, be understood that the supply pipe 9 and the pipes 21, 22 and 23 have a common source of air supply and may each be independently controlled.

The operation, method of use and advantages of the invention will be readily understood from the foregoing description, taken in connection with the accompanying drawing and the following statement:

Compressed air being admitted at the base of the liquid column in the tube A, such air in rising through the column will form in pockets or the like similar to the pockets illustrated in Fig. 2 in the rise of the column of air and liquid in which such air is entrapped. The valve C being interposed in the path of the ascending liquid and air and at the point where the air is about to lose its efficiency with respect to further propulsion of liquid, the effect of the valve and the seat on the passing air and liquid will be to destroy the arrangement of the air pocket and liquid, thus creating a new stage in the operation of the pumping apparatus, the further rise of the air and water past the cone 13 redistributing such air and water so that further upward progress will be under more favorable conditions than would be the case without rearrangement.

Having thus disclosed my invention, I claim and desire to secure by Letters Patent:

1. In apparatus of the character disclosed, in combination, a pump tube, means for supplying a working fluid to the interior of said tube for intermingling with liquid to be pumped, valves dividing said tube into a lower section and an upper section thus providing a plurality of stages through which the liquid being pumped progresses, and means over each valve for re-arranging and re-applying the working fluid with respect to the liquid.

2. In pumping apparatus of the air-lift type, in combination, a tube, means for supplying working fluid to the tube, and means interposed in the path of ascent of the working fluid and fluid to be pumped to break up relative arrangement of working fluid and fluid to be pumped, and means to re-arrange said fluid comprising a member mounted within and materially restricting the passage through the tube.

3. In pumping apparatus of the air-lift type, in combination, a tube, means for supplying working fluid to the tube, and means interposed in the path of ascent of the work-

ing fluid and fluid to be pumped to break up the relative arrangement of working fluid and fluid to be pumped at the zone of such interposed means; said interposed means including a valve; there being likewise means adjacent to said valve for reapplying said working fluid to the work of further assisting said fluid being pumped in its ascent.

10 4. In an air-lift pump, in combination, a tube, means for supplying elastic working fluid to the interior of said tube and in a lower zone thereof, and means interposed in the path of ascent of the working fluid and restricting the passage through the tube  
15 in a higher zone than the zone of supply of said working fluid for reapplying said working fluid to other fluid to be pumped.

5. In an air-lift pump, in combination, a tube, means for supplying elastic working fluid to the interior of said tube and in a lower zone thereof, and means interposed in the path of ascent of the working fluid and in a higher zone than the zone of supply of said working fluid for reapplying said working fluid to other fluid to be pumped; said last named means consisting of an inverted cone.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

DAVID W. JONES.

Witnesses:

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J. SHUTT.